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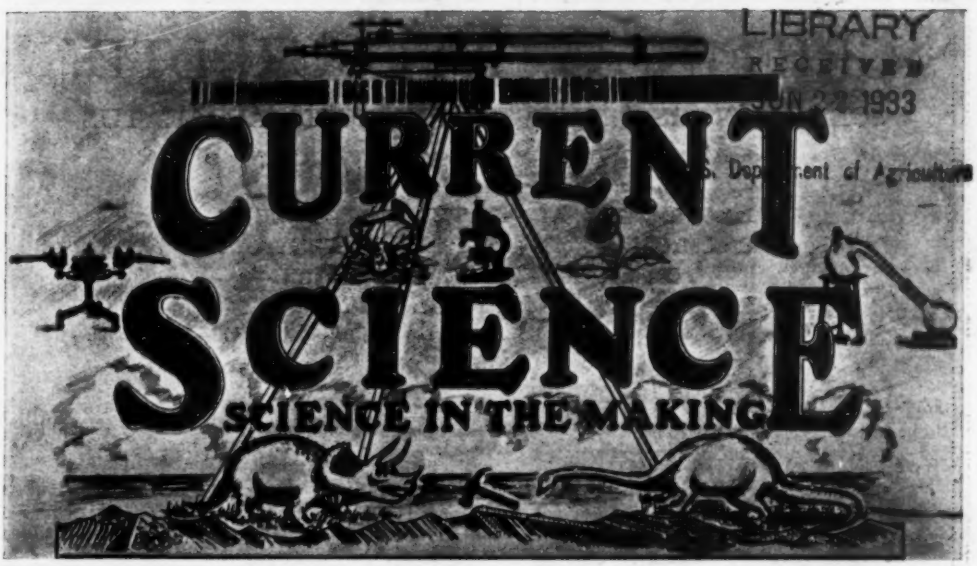

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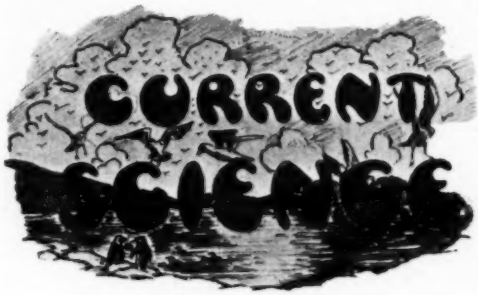

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CONTENTS.

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An Indian Academy of Science.

GENERALLY speaking the progress of scientific investigation is regulated by the generous enthusiasm of scientific workers and the financial support received from Government or the discerning public. In India it has attained a stage at which further advancement can best be secured by organising and co-ordinating the laboratory operations of official and non-official research departments. Although Indian science should command practically unlimited resources, and actually has enlisted a band of competent and highly qualified investigators, it suffers from inadequate financial support and from the lack of an authoritative exposition of its achievements by a central responsible body which can speak on behalf of her scientific men for India as a whole. The conviction that research is civilisation, and determines the economic, social and political development of a nation has not yet been unreservedly accepted as part of the administrative policy of India, and we are disposed to ascribe the tardy and perhaps unwilling recognition of this fundamental fact to the absence of an all-India scientific organisation whose function would be to concentrate enlightened public opinion on the doctrine that science is material and spiritual wealth. Neither India nor the outside world has at present the means of receiving a complete picture of the total annual output of scientific work conducted under the auspices of Government, the universities and other semi-official centres. Some of the results are found in journals and magazines published by governmental scientific institutions, all-India societies and the universities; but papers of outstanding merit frequently gravitate to foreign periodicals. It seems to us that the early establishment of a National Academy of Science should secure closer and better organised co-operation of activities among all research institutes in India, and exercise through its official journal a wider influence for the consolidation and promotion of the best interests of science.

It is true that individual scientific workers in India have by their indefatigable industry achieved great distinction for themselves, but the prestige of both official and non-official research is still slow in attaining that status of international importance reached

by most European countries. This unsatisfactory position is in our opinion partly due to the tendency of many scientific men to export their more important contributions for publication in foreign journals, with a proportionate impoverishment of Indian archives. Perhaps if the resources of an all-India journal such as we contemplate in connection with the Academy of Science, had been available for giving Indian scientific work suitable international publicity, the outflow of memoirs from this country would have been more restrained and less voluminous. Continuance of this practice will retard the process of building up a scientific tradition for India and keep her in a position of semi-dependence in the world of science. While the foundation of the scientific reputation of a country is established by the quality of work produced in its institutions, the superstructure is reared by the national journals which proclaim their best achievements to the rest of the world. Manifestly the edifice of science in India is incomplete. If scientific contributions from countries which possess national journals are also sent abroad, let it be remembered that they represent a surplus, broadcasting the embellishments of their own national organisations. It is true that the spirit of science and its service are international, but is it not also true that every nation has its own Academies, learned societies, magazines and journals? India will have to organise and develop her national scientific institutions before she can enter into the comity of international scientists. The achievements of Indian science are national assets, and an Academy which treasures and displays them collectively is assured of providing the necessary guidance and inspiration for the younger generation to put forth greater exertions in order to enrich and widen the usefulness of this great estate.

We believe that there will be a general concurrence of opinion supporting the speedy establishment of an Indian Academy of Science with an *Indian Journal of Science* as its official organ for the publication of papers having outstanding merit. Our proposals need not excite any apprehension as to the fate and fortune of the numerous scientific institutions and journals conducted under the auspices of Government, the universities and other unofficial bodies. According to our scheme these will continue to function as before, and the Academy which in some respects may be regarded as their apex will assist rather than assume an attitude of unfriendliness towards them. Government are maintaining six scientific surveys besides ten or more research departments publishing their own journals and bulletins. Nearly all the eighteen universities provide facilities for research and some of them conduct journals. The U. P. Academy of Sciences is the official expositor of research work conducted in the regional universities of the Gangetic valley. The *Indian Journal of Physics*, issued by the Indian Association for the Cultivation of Science, is intended to reflect the scientific results obtained in all the universities. Nearly all the learned societies publish important papers in their journals and some of them have wide circulation. It seems to us that the ground has been thoroughly prepared and the foundation has been laid by these institutions and their organs for the establishment of a central body whose functions will not be permitted to overlap, but will aim at co-ordinating them by establishing cultural contacts. Most of the universities are interested in problems of pure science and through the influence of the Imperial Council of Agricultural Research, their active sympathies are enlisted by a system of special research grants, for the investigation of agricultural topics. The Academy of Science will be an authoritative body of scientists dealing with the more important papers, which they will discuss in their sectional meetings and publish in their proceedings or transactions for which the widest possible publicity will be secured. The scope and purpose of the functions of the Academy are therefore different from those of the Indian Science Congress which offers principally the advantage of human contacts while giving opportunities to discuss the preliminary stages of work still in progress. Thus the aims of the two institutions will be distinct, but complemental.

Among other functions which the Academy will exercise should be included the protection and advancement of the professional interests of its members. It should acquire the necessary authority to advise Government, the universities and other institutions on all scientific matters and other problems referred to it for consideration and to negotiate on behalf of Indian scientific workers with similar institutions abroad. The weight and influence of the Academy may be also most usefully exerted in connection with

securing an adequate statutory provision of grants for all the scientific departments depending on them. Financial stringency is often pleaded as an excuse for diminishing subsidies already insufficient, and although laboratory equipment is expensive, administrative authorities require to be convinced that the price of industrial prosperity is continuous and intensive research. The psychological moment for increasing the research grants appears to be the period when "depressions" overtake the country, for the history of industrial progress testifies that these depressions are due not only to political causes but to a lack of scientific imagination on the part of the industrialists and statesmen. Financial depression is a Handwriting on the Wall, and the only correct interpretation of this message is that scientific research has to be reorganised to cope with the wasteful industrial competition due to over-production. The nation which can foresee and make anticipatory provision is destined to tide over all depressions. It is in such situations that the services of the proposed Academy will be most appreciated, and the knowledge of the scientists will find opportunity for application in the economic, social and political regeneration.

The absence of a central consultative library which imposes a handicap on the progress of research is a subject for consideration by the Academy. At present reference works from the universities are procurable through personal influence, but stringent rules enforced by other libraries reserve the usefulness of the books and magazines to the members of those libraries. The Indian Scientific Surveys lend books and journals to all recognised institutions and scientific workers but the inadequate funds at their disposal must necessarily limit the number of works they can subscribe for or purchase. The organisation of a central reference library under the auspices of the Academy and its administration will necessarily entail a heavy outlay including provision of a suitable building for housing the books and journals. Through its library the Academy will act as a bureau of information to be disseminated among its members. This is the principal direction in which the Academy will supplement the efforts of the existing institutions to further the progress of scientific investigations in the pure and applied branches of knowledge.

The Academy will be a company of thinkers, workers and expounders comprising members of the New Estate upon whose achievements the world must in future depend for the preservation and advancement of civilisation. Their professional spirit must be service, rendered with absolutely no thought of personal advantage. The amount of knowledge they place at the disposal of their country will determine its economic, social and political progress. An Academy of Science is not an ornament, but an indispensable institution for directing the destinies of the nation. We have no hesitation in thinking that its establishment ought to be the natural and legitimate ambition of a progressive government and an enlightened public who should unstintingly provide the institution with sufficient funds for its service in their cause.

Recent Discovery of Fossil Reptilian Remains in the Central Provinces.

DINOSAURS were known to occur in the Cretaceous rocks in Peninsular India as early as 1828, when Major-General (then Capt.) Sleeman collected a few imperfect bones from the Lameta beds of Jubbulpore. Rev. Hislop also made a collection of saurian remains from the surface of a ploughed field at Pisdura, a small village in the Chanda district. In any case nothing much was known about the Indian Cretaceous dinosaurs. As a matter of fact the genus Titanosaur which forms the type genus of the family Titanosauridæ was established by Lydekker from two caudal vertebræ from Jubbulpore.

Prior to 1917 our knowledge of the Indian dinosaurs was limited to a couple of teeth of the carnivorous type and a few broken bones and caudal vertebræ of the non-carnivorous type. No attempt, however, was made to undertake any systematic search of dinosaur remains until 1917 when Dr. C. A. Matley, then Deputy Controller of War Accounts, an enthusiastic amateur geologist, accidentally came across a limb bone at the Bara Simla hill at Jubbulpore while he was preparing a detailed geological map of that region in his spare time. The possibility of obtaining more dinosaur remains by systematic excavation into the Lameta beds

there was suggested by him and between the years 1917-19 with the help of Mr. D. S. Bhattacharjee, who was specially lent by the Geological Survey of India, he was able to make a large collection of the remains of sauropodous and theropodous dinosaurs from Jubbulpore and its neighbourhood. The specimens, which are the property of the Geological Survey of India, were studied by Prof. F. von Huene of Tubingen University, one of the leading authorities on fossil reptiles, in collaboration with Dr. Matley. The result of their study, published in the *Palæontologia indica*, has added eleven genera (of which nine are new to science) to the former scanty list of Indian dinosaurs. Of the sauropods, two genera hitherto unknown in India are found; they are the South American genera *Antarctosaurus* and *Laplatosaurus*. In addition, eight new genera of carnivorous dinosaurs and a new stegosaurian genus—*Lametasaurus*—have been established. Of the many interesting facts brought out by the study of these Indian dinosaurs two stand out very prominently. One of them is that all the three sauropod genera of India, *viz.*, *Titanosaurus*, *Antarctosaurus*, and *Laplatosaurus* are found in regions so far away as Patagonia and other parts of South America, while remains of *Laplatosaurus madagascariensis*, an essentially Madagascar species, are found at Pisdura in the Chanda district. The other is that the *Antarctosaurus* scapula from Jubbulpore, measuring over 5 feet in length, is probably one of the largest ever recorded in dinosaurs.

Dr. Matley again came out to India in 1925 and collected a number of scattered dinosaur bones from the Cretaceous beds of South India near Ariyalur in the Trichinopoly district.

In November 1932 Dr. Matley, now an aged man of 68 years, started on a fresh expedition under the auspices of the Percy Sladen Trust, with a view to collect reptilian fossils for the Natural History Museum, South Kensington, London. The expedition had the active co-operation of the Geological Survey of India and the services of Mr. A. M. N. Ghosh, B.Sc. (London), A.R.C.S., Extra Assistant Superintendent, were lent to it. The expedition made an extensive tour over the Lameta outcrops in the Jubbulpore and Chanda districts of the Central Provinces and in Rewa State.

The collection from Chanda district consisted of Titanosaurid vertebral centra and broken limb bones picked up from the surface of a ploughed field near the village of Pisdura, and fragments of chelonian carapace and limb bones. Coprolites, big and small, some of them bearing clear intestinal impressions, were also obtained. Excepting two broken limb bones found at Ghunghuti, the Lameta beds in Rewa State did not yield anything worth mentioning. The search for dinosaur remains from the Lameta beds of Jubbulpore district was equally disappointing. The expedition finally met with success at Jubbulpore where excavations were conducted in the green-sand zone of the Lameta series at Chota Simla hill and it succeeded in collecting a large number of remains of sauropodous and carnivorous dinosaurs and a few scutes of an armoured dinosaur. The sauropod remains were represented by the hind and fore limbs of one individual—a titanosaurid, calcaneum and metapodial bones, caudal vertebræ, bones of the pelvis, ribs and hæmapophyses. The more complete of the two femurs was found to be 51 inches long, the tibia and the fibula each measured 32 inches in length and the humerus 36 inches. All the specimens were in a perfect condition of preservation and came from near the junction of the green-sand and the overlying limestone.

The theropod bones were much more difficult to handle. The extreme thinness and spongy texture with the sandy matrix filling up the bony interspaces rendered removal in the field very difficult and identification almost impossible. However, several teeth and ribs were found intact, and a theropod claw, a humerus and scapula were in a good state of preservation. Several theropod vertebræ, two of which were complete with vertebral processes, and a part of a sacrum with three sacral vertebræ carrying a couple of sacral ribs, were amongst the notable finds.

From the above it will be apparent that remains of all the three varieties of dinosaurs were discovered by the present expedition. Want of time prevented further excavation but it is quite likely that more reptilian remains will fall to the efforts of parties engaged in making organized and systematic search of these wonderful creatures, the lords of creation during the Mesozoic era of the earth's history.

Lt.-Col. Robert Beresford Seymour-Sewell, M.A., Sc.D., F.Z.S., F.A.S.B., I.M.S., C.I.E.

LT.-COL. ROBERT BERESFORD SEYMOUR-SEWELL, the second permanent Director of the Zoological Survey of India, was born at Leamington, England, on 5th March 1880 and after a very distinguished career of nearly 25 years of service in India has gone on leave preparatory to retirement from 22nd April 1933.

Sewell was a scholar of Weymouth College from 1894-98, and after studying for a short time in the University College, London, joined Christ's College, Cambridge, in 1899. He was in Cambridge till 1905, where he had a very distinguished career first as a student of pure science and later as a medical student. His medical studies were continued in St. Bartholomew's Hospital, London, and after taking the M.R.C.S., L.R.C.P., of London in 1907, he passed the competitive examination for the Indian Medical Service in 1908.

Lt.-Col. R. B. Beresford Seymour-Sewell, M.A., Sc.D., F.Z.S., F.A.S.B., I.M.S., C.I.E.

After serving as a medical officer in the Indian Army for a couple of years, Sewell, in view of his scientific qualifications, was appointed the Surgeon-Naturalist to the Marine Survey of India on board the R.I.M.S.S. "Investigator" in September 1910. In December 1911, he was selected to officiate as Professor of Biology in the Calcutta Medical College and it was not till July 1913, that he resumed his office of the Surgeon-Naturalist. He reverted to military duty on the outbreak of the World War, and saw active service at Aden, in Egypt and Palestine. For a time he also acted as the Health Officer of the Port of Aden, and was mentioned in Despatches for his work during the War. His services were replaced at the disposal of the civil authorities in 1919, and after serving as Officiating Superintendent, Zoological Survey of India, for a year, he reverted to his permanent post of Surgeon-Naturalist. In 1925 he was appointed Director, Zoological Survey of India.

The biological investigations of the Marine Survey of India, which had been carried on for some 35 years when Sewell was appointed Surgeon-Naturalist, had been mainly confined to systematic surveys and making collections of marine faunas, particularly of the deep-sea forms, of the areas visited by the Survey ship. In 1911 Sewell found that the opportunities for deep-sea trawling, etc., were less frequent, and it would, therefore, not be possible to carry out the programme of the biological work on the deep-sea fauna on the lines followed by his predecessors. Quite early in his career he also recognized that there was an almost virgin field of study regarding the physical conditions under which the marine animals live in the tropical waters and he, therefore, started his investigations in detail. The so-far published results of his researches in a special volume of the *Memoirs of the Asiatic Society of Bengal* deal with the geography of the Andaman Sea and the Bay of Bengal, the temperature and salinity of the coastal and deeper waters of the Andaman Sea and the Bay of Bengal. He has also collected material on the oceanography of that part of the Arabian Sea known as the Laccadive Sea and studied in great detail the formation of coral reefs and coral islands in the Andamans, the Gulf of Mannar and the Maldives.

With restricted facilities for pure biological work Sewell concentrated on the littoral fauna and a detailed study of the marine Copepoda. He was the first to use nets for fishing in mid-water and the results obtained by him in 1911–12 showed how highly promising this field for biological work is. Sewell did not neglect the deep-sea fauna, for in 1912 he published a paper on the deep-sea fishes and another in

collaboration with Dr. S. W. Kemp on the Decapods dredged by the "Investigator" during the Survey Season 1910–11.

In connection with the systematic survey of the fresh water molluscs of India, started by the Zoological Survey of India in 1918 at the request of the medical authorities, Sewell published in 1921 a detailed anatomical and bionomical work on the common banded snail—*Viviparus bengalensis*. About the same time he took up the study of the cercariæ which occur in the indigenous fresh water molluscs of India, and this resulted in a number of papers and a very elaborate monograph which was reviewed by one of the leading authorities in the following words:—

> ".... The author has given a study of the cercariæ of India that surpasses in extent and thoroughness any study hitherto made of this group in any part of the world..... Suffice it to say that it is sure to be indispensable to all workers in this field."

Since his appointment as Director, Zoological Survey of India, Sewell has published two elaborate monographs on marine Copepods and has also devoted special attention to the biological conditions governing the life of animals in estuaries and in restricted areas of fresh water.

While in Cambridge, Sewell turned his attention to anatomical studies which were of special importance from the biological and anthropological points of view. Prof. Havelock Charles from his studies of the morphology of the lower extremity of the Punjabi adults and fœtal skeletons had concluded that the facets on certain bones of the lower extremity offer a good example of the inheritance of a character acquired by the Punjabi in the evolution of its racial type. Sewell, from a careful study on the *astragulus*, based on the skeletons of Egyptians of the pre-dynastic Nagdah race, of the Fifth Dynasty to the Ptolemaic and Roman period, of Europeans and others, was able to show that the peculiar "facets occur in the fœtus of the European, and probably all other races, whether the facets are found to be present in the adult or not"; he was thus able to disprove the hypothesis of the inheritance of an acquired character as postulated by Prof. Havelock Charles. On the appointment of an Anthropologist on the staff of the Survey in 1927, Sewell was able to revive his early interest in Anthropology and this resulted in a number of valuable contributions on the racial ethnology of the Indians. He also worked out the human and animal remains excavated from the pre-historic site at Mohenjo-Daro and at Mekran; the papers on the human remains were prepared in collaboration with Dr. B. S. Guha, Anthropologist of the Zoological Survey of India.

Sewell was elected a Fellow of the Asiatic Society of Bengal in 1917 and within recent years was awarded the Sc.D. degree of the Cambridge University. He was a Fellow of the Calcutta University (1930-31) and did extremely valuable work in connection with the reorganization of the teaching of Zoology in the University. He was elected President of the Zoology Section of the Indian Science Congress in 1927, of the Anthropological Section in 1929 and was the President of the Indian Science Congress in 1931. In 1930 he acted as the Chairman of the Quinquennial Reviewing Committee of the Indian Institute of Science, Bangalore. He was the President of the Asiatic Society of Bengal from 1930-32 and was awarded the Barclay Memorial Medal in 1932. For his services to the cause of Science in India he was awarded the title of C.I.E. in the New Year's Honours List of 1933.

During his tenure as Director, Zoological Survey of India, Sewell's time was greatly taken up by administrative work and he worked out in detail several schemes of far-reaching importance in connection with the work of the department. Most of these schemes, such as, the erection of a fire-proof spirit building for the reserve collections and offices of the department, an increase in the staff, and the establishment of a marine biological station at Karachi, were administratively approved and it appeared almost a certainty that the department would before long be properly housed, equipped and manned for survey work. Unfortunately, as a result of the acute financial depression during 1931-32, not only were all the schemes of expansion shelved, but very drastic reductions were effected both in the personnel and in the annual budget grants of the department. The same circumstances are responsible for his premature retirement, but it is to be hoped that with the return of normal conditions the schemes for the expansion of the department initiated by Sewell will be revived and that it would be possible to carry out the programme of the work of the department as outlined by him.

Colonel Sewell is personally a very charming man, always ready to help his colleagues and assistants in every possible way, and his loss to the Zoological Survey, due to his premature retirement, will be keenly felt. Fortunately, retirement from service does not mean severing his connection with Indian Science, as he has been selected as the leader of the "John Murray Oceanographical Expedition" which will be working in the Arabian Sea from the Persian Gulf down to the level of Madagascar, and east to west between India and Africa. In addition to general oceanographical investigations the Expedition will pay special attention to the zonation of the fauna on the continental slopes between 50-1000 fathoms and the nature of bottom deposits, while depth-soundings will be carried out in traverses extending over the entire area with a view to elucidating the much-debated land connections or bridges between the two continents in the pre-historic times. His colleagues and other scientists in India will follow the progress of the John Murray Expedition with great interest and sincerely hope that the completed results of his work on this Expedition will bring credit to him and his old department.

B. P.

Silken Shelters of Torrential Insect-Larvæ.*

By Dr. Sunder Lal Hora, D.Sc., F.R.S.E., F.L.S., F.Z.S., F.A.S.B.,
Zoological Survey of India, Indian Museum, Calcutta.

THERE is quite a large number of torrential insects, whose larvæ spin thin silken-sheets[1] on exposed surfaces of rocks in moderate or swift currents, and, it is presumed that normally they live underneath them for safety. The silken-shelter is usually made by covering over a crevice or a groove caused by inequalities of the rock surface. Sometimes only the groove is bridged over, as in *Antocha* and *Elliptera* (Tipulidæ: Diptera), while in other cases simple or elaborate galleries are also formed extending in all directions, as in the Philopotamidæ (Trichoptera), *Aulacodes* and *Elophila* (Lepidoptera) and *Charadromyia* (Chironomidæ: Diptera). When observed in the natural condition, these shelters appear very turgid and well distended, but when taken out of water they readily collapse. One would be inclined to think that under the pressure of the swift current, the silken sheets would lie closely pressed to the substratum, thus interfering with the free movements of the animals beneath them: but in reality this is not so, for, as will be seen presently, the swiftness of the current is the main factor that is responsible for pulling the silken sheets upwards and thus keeping them properly distended. Paradoxical as it may appear, the upward pull on the sheet increases with the swiftness of the current, and thus the animal below it lies in a world different altogether from what its congeners have to face in the open on bare rocks.

Fig. 1.

Larval shelters of a Philopotamid larva which was found to be very common in a small stream near Peebles, Scotland. The larval cases were found on pebbles and stones in swift current and were covered with a mixture of slime and mud. Notice the elongated nature of the shelters.

The hydraulic principle involved may best be illustrated by analysing the forces of the currents round about the pupal-chamber of the *Aulacodes*. The pupal shelter of the *Aulacodes* is dome-shaped and is provided with openings at both ends in order to permit the free circulation of water below the pupal-chamber (P), as is shown in the accompanying diagram. As the pupal shelter lies firmly cemented to a rock in

* Published with the kind permission of the Superintendent, Zoological Survey of India.

[1] For an account of the silken-shelters of the torrential insect-larvæ see my paper on the "Ecology, Bionomics and Evolution of the Torrential Fauna" in *Phil. Trans. Roy. Soc., London*, (B) **218**, 171, 1930.

swift current, the water glides smoothly over its stream-line body-form. Even so the current at A will be slightly retarded as compared with that at C. But the water that enters the pupal shelter at O flows into the area B, marked with arrows, and in this enclosed area its velocity is greatly retarded. The hydraulic principle to be considered here

Fig. 2.

Silken-shelter of an *Aulacodes* larva (from a photograph). Notice the extensive galleries that radiate in all directions.

is the same as that which governs the flow of water through pipes. In accordance with this principle, when water flows through a pipe, the sum of the pressure energy $\left(\frac{p_1}{w}\right)$ and the velocity energy $\left(\frac{v_1^2}{2g}\right)$ at one point of the tube is equal to the sum of the pressure energy $\left(\frac{p_2}{w}\right)$ and the velocity energy $\left(\frac{v_2^2}{2g}\right)$ at another point of the tube. By the principle of the conservation of energy, and neglecting frictional losses, the energy at any two points of a tube may be equated as follows:—

$$\frac{p_1}{w} + \frac{v_1^2}{2g} = \frac{p_2}{w} + \frac{v_2^2}{2g} \text{ (per pound of water).}$$

w = weight of one cubic foot of water.
g = force of gravity.
p = pressure.
v = velocity.

Now since the velocity is greater at C (see the diagram) than at B, it follows that the

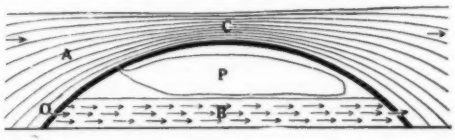


Fig. 3.

Pupal shelter of *Aulacodes* (Diagrammatic, after Pruthi but greatly modified).

pressure at B must be greater than that at C. This means that a 'partial vacuum' is

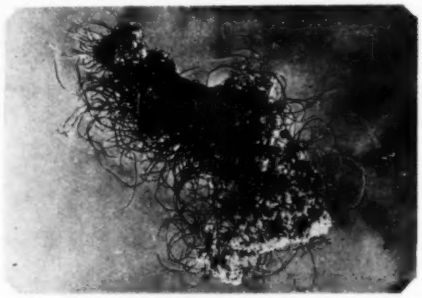


Fig. 4.

A portion of a larval shelter of *Aulacodes* showing a profuse growth of algæ on its upper surface. A part of the shelter is turned over to show the absence of algal growth on the inner surface.

produced at C, which will have the effect of pulling the pupal shelter upwards and thus giving it a dome-shaped appearance. It will also be clear that as the velocity of the current at C increases, the pressure will fall still further at that point, so that the vacuum produced will be stronger. This explanation applies with equal force to the larval shelters also. It is thus seen how, in the economy of life, the forces of nature are usefully employed by organisms.

What is the function of the silken sheets? So far it has been believed that it provides only shelter to the animal concerned. I have myself subscribed to this view. But on a closer examination of the subject, it seems to me highly probable that these devices serve to snare or entangle food particle on which the animal feeds. In this respect the shelters will correspond to the snares of spiders. In the so-called water-spiders, *Hydropsyche* (Trichoptera), that live in conical snares in swift currents, there is no doubt that the shelter is used for snaring

food particles. There are certain Chironomid larvæ which cover the mouth of their tubes with loose-spun silk. This cover acts as a snare for the minute organisms and after a time the larva devours this covering along with the food particles. Similarly, I find that the larvæ of *Aulacodes* feed on the algæ that get entangled in the sticky substance of their silken shelters. The primary function of these shelters then seems to be to act as snares. There is no doubt that they provide a certain amount of shelter to the animal against the swift currents, but it should be borne in mind that the larvæ are capable of living in swift currents without the shelters. For instance, when the larvæ begin to make their shelters, they have to crawl to suitable places and it must take them some appreciable time to make the shelters before they could take refuge in them. Moreover, in *Aulacodes* at least, the larva probably goes on adding galleries afterward, so as to increase the area of its pasture.

This view regarding the function of the silken shelters is further strengthened by the fact that among the brook inhabitants, those that have taken to feeding on microplanktonic organisms, have evolved complicated and ingenious devices to strain minute particles of food out of the rushing current. Among insects reference has already been made to the snares of the *Hydropsyche*,[2] but the fans of Simulium (Diptera), and the bristle-fringed legs of *Chironetes* (Ephemeroptera) and *Brachycentrus* (Trichoptera) serve the same purpose. Reference may also be made to the feeding mechanism of the funnel-mouthed tadpoles of the genus *Megalophrys*.[3] The insect larvæ, like those of the *Aulacodes*,[4] that manufacture silken shelters have no special structural devices for gathering planktonic food, and it seems highly probable, therefore, that the sheets act as snares and thus provide feeding grounds for these animals.

[2] Needham and Lloyd, *Life in Inland Waters*, p. 365 (1916).

[3] Hora, *Rec. Ind. Mus.*, **30**, 139, 1928.

[4] Pruthi, *Rec. Ind. Mus.*

Letters to the Editor.

A Note on the Magnetic Susceptibilities of Cuprous Oxide Films.

WHEN a thin strip of metal is heated by insertion of an edge of it in a bunsen flame, a very thin layer of an oxide film is formed on the metallic surface. The structure of these oxide surfaces has been studied by J. A. Darbyshire[1] and also by W. L. Bragg and J. A. Darbyshire,[2] who have shown by the method of electron diffraction that in the case of copper, the oxide that is formed is of the usual cubic structure of cuprite, Cu_2O. As the composition of the film is a controversial question and the literature describes the film to consist of a mixture of Cu_2O and CuO, it has been considered desirable to examine the question from a magneto-chemical point of view.

The cuprous oxide in the powdered state, when pure and not contaminated with CuO, has been found to be diamagnetic with a value of χ equal to $-0{\cdot}188\times10^{-6}$ as determined by the Bhatnagar-Mathur Magnetic Interference Balance. The literature on the subject of the magnetic properties of Cu_2O is highly controversial. For example, the *International Critical Tables*, Vol. VI, page 357, describe the substance to be paramagnetic with a value of $+1{\cdot}2\times10^{-6}$, whilst E. H. Williams[3] describes the cuprous oxide to be diamagnetic. Klemm and Schüth[4] have also recently found that Cu_2O has a value χ equal to $-0{\cdot}18\times10^{-6}$ and is diamagnetic. This value of the susceptibility of cuprous oxide is in good accord with the figure $-0{\cdot}188\times10^{-6}$ obtained by us. Two different samples of Cu_2O, prepared by different methods: (i) by the reduction of alkaline $CuSO_4$ with glucose; and (ii) by the electrolysis of a hot boiling solution of NaCl, between copper electrodes, have been examined by us. In both these cases the Cu_2O was found to be diamagnetic and the values of χ were $-0{\cdot}188\times10^{-6}$.

The next step was to examine the films of oxides on copper. They were prepared firstly by heating a clean piece of copper

[1] J. A. Darbyshire. *Trans. Faraday Soc.*, **27**, 675, 1931.

[2] W. L. Bragg and J. A. Darbyshire. *Trans. Faraday Soc.*, **28**, 522, 1932

[3] E. H. Williams. *Phys. Rev.*, **28**, 167, 1928.

[4] Klemm and Schüth. *Z. anorg. allgerm. Chem.*, **203**, 104, 1931.

foil as described by Darbyshire and secondly by following the method of Sebatier and Senderens which consists in heating the metallic foil in an atmosphere of nitric oxide to a temperature of about 250°C. A very fine film of copper oxide was formed on the metallic surface, in both the cases. These films are supposed to consist of Cu_2O only and no CuO is supposed to be formed. The films so prepared were removed from the surface of copper by the method employed by U. R. Evans[5] and on investigation were found curiously enough to be definitely paramagnetic, as against the Cu_2O in bulk which we showed definitely to be diamagnetic. There are only two explanations of this behaviour. Firstly, that the film is contaminated with a paramagnetic material, possibly the CuO and secondly, that the magnetic properties of the Cu_2O in film are different from those of the substance in bulk. The second view is not possible on account of the fact that Cu_2O was prepared by different methods and consisted of all sizes of particles. The values of χ however in all the cases of different sizes of particles were nearly always equal to $-0{\cdot}188\times10^{-6}$ both in our experiments and in those of Klemm and Schüth. Also in view of the recent work of Lane[6] that the particle size of the film of bismuth has no effect on its susceptibility and that the films examined are paramagnetic, it looks likely that the impurity responsible for the paramagnetism of these films is the production of a trace of the paramagnetic CuO. Further support in favour of this view comes from a recent entirely different investigation of G. Athanasiu,[7] who, in course of his investigations on the spectral sensitivity of photovoltaic piles of copper electrodes coated with Cu_2O, has shown that the presence of a trace of CuO in the sub-oxide tends to diminish the E.M.F. produced by light and also displaces the maximum of sensitivity towards the red end of the spectrum. He coated the plates of copper with thin films of Cu_2O by three different methods and the effects obtained by him are in some cases positive and in others negative, depending on the presence or absence of CuO, as a contamination in the Cu_2O films. According to this author, the films prepared by heating copper in electric furnace contain a good amount of CuO. When these black scales of CuO are removed the positive effect noted above on the photo-galvanic effect of Cu_2O is totally suppressed.

From the magneto-chemical data and the work of Athanasiu it appears probable that the Cu_2O films prepared in the manner described in this paper, contrary to the evidence obtained by Bragg and Darbyshire, consist of a mixture of both Cu_2O and CuO. A fuller account of the work will be presented elsewhere.

S. S. BHATNAGAR.
N. G. MITRA.

University Chemical Laboratories,
University of the Punjab, Lahore,
April, 1933.

[5] U. R. Evans. *Jour. Chem. Soc.*, 2651, 1929.
[6] C. T. Lane. *Nature*, December 31st, 1932.
[7] G. Athanasiu. *Comptes Rendus*, **195**, 767, 1932.

The Presence of Scattered Vascular Bundles in the Stem of *Elatostema sessile*.

IN the vast majority of the Dicotyledons the vascular bundles of the stem are arranged in a ring; hence an observation to the contrary is naturally of interest.

Material of *Elatostema sessile*, a member of the family Urticaceæ, was collected from Mussourie and pieces of stems of various ages were sectioned. It was found that in the greater part of the stem the bundles are irregularly scattered, the larger ones being towards the outside and the smaller towards the centre (Fig. 1). Fig. 2 shows one of

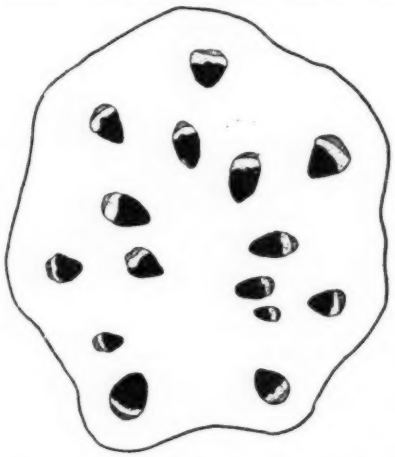


Fig. 1.

these bundles at a higher magnification. It is only at the base of the stem that the bundles are arranged in ring and there is a continuous cambium cylinder with normal

secondary growth. An almost similar condition is known to exist in *Podophyllum peltatum*.

So far as I know, such a behaviour has not been recorded before in the family Urticaceæ. A detailed investigation is in progress and the results will be published elsewhere.

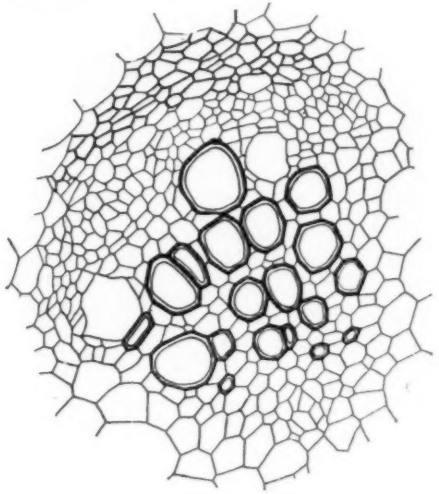


Fig. 2.

The figures were drawn at my request by one of my students Mr. Bahadur Singh, M.Sc.

PANCHANAN MAHESHWARI.

Department of Botany,
Agra College, Agra,
3rd April, 1933.

The Raman Effect of Fused Inorganic Nitrates.

THE Raman Effect of inorganic nitrates in solution and as powdered crystals has been studied by a number of investigators and the normal vibration frequencies of the NO_3 ion, theoretically calculable from a plane equilateral triangular model, are known to be present in the scattered spectrum of these compounds. It is also well known that these free ionic frequencies are modified to a certain extent by the physical state in which the substance is studied. For example, in crystals these frequencies have higher values than in solutions. It will be interesting to study how far the fused state of the substance affects these natural frequencies. With this purpose in view we have investigated a number of inorganic nitrates (whose melting points are below 600°C) in which the Raman spectra are obtained with the substance maintained in a molten condition in a specially constructed electrical furnace. The full report of the investigation is in course of publication and we give below the results obtained with sodium and potassium nitrates only.

	Solution	Crystal	Fused salt
$NaNO_3$	725 1048 1361	720 1066 1383	715 1054 1393
KNO_3	730 1049 1357	711 1051 1350	721 1052 1343

In sodium nitrate so far as the inactive frequency at $9{\cdot}5\,\mu$ is concerned the fused state occupies an intermediate position between the crystal and the solution while in potassium nitrate this oscillation is apparently uninfluenced by the physical state. This independence of the inactive frequency upon the physical state becomes more and more apparent as the weight of the metallic radical increases. Thus the greatest discrepancy is shown only in lithium and in sodium. With regard to the active frequencies there does not seem to be any systematic variation. The very short shifts observed in crystals and associated with the lattice structure are not obtained in the fused salts.

V. N. THATTE.
A. S. GANESAN.

College of Science,
Nagpur,
April 15, 1933.

Boring Apparatus in Balantidium.

SINCE Ray[1] pointed out the presence of a boring mechanism in *Balantidium sushilii* from *Rana tigrina* Daud, I have examined several other species of Balantidium from the same host and *Bufo melanostictus* Schneid, available in Calcutta. From the accompanying *camera lucida* drawings of

[1] Ray, 1932. "On the Morphology of *Balantidium sushilii* n.sp., from *Rana tigrina* Daud." *Jour. Roy. Micros. Soc.*, **52**, 374-382.

B. elongatum Bezz., *B. helenæ* Bezz., and *B. rotundum* Bezz., it will be clearly seen that such a mechanism is also present in these species and that the borer (*b*) in each case is connected with an axial system of fibres (*ax*). Other fibres which are purely morphonemic in nature, as pointed out by

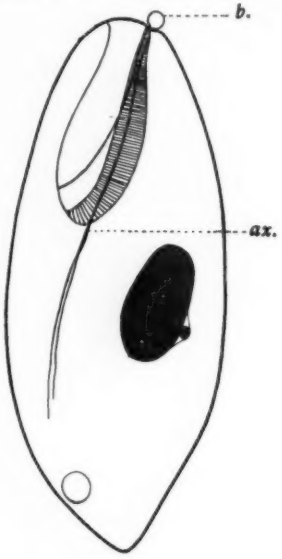


Fig. 1.
B. elongatum Bezz. × 555

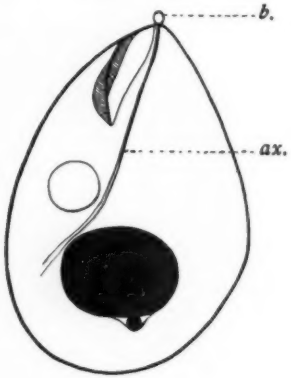


Fig. 2.
B. helenæ Bezz. × 555

Ten Kate[2] are, no doubt, present in these species of Balantidium, but as to the function of the axial system of fibres here, I am inclined to agree with Ray, in suggesting that they have got some sort of motor function as well.

In the cytoplasm of all these species of Balantidium I have also been able to

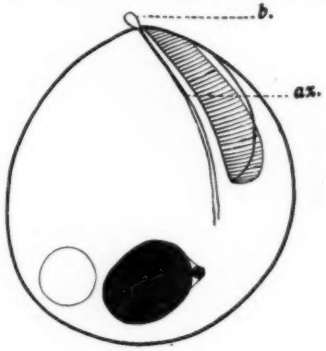


Fig. 3.
B. rotundum Bezz. × 555

demonstrate the presence of red-blood corpuscles by various methods of differential staining.

Detailed observations on these will soon be published elsewhere.

MUKUNDA MURARI CHAKRAVORTI.

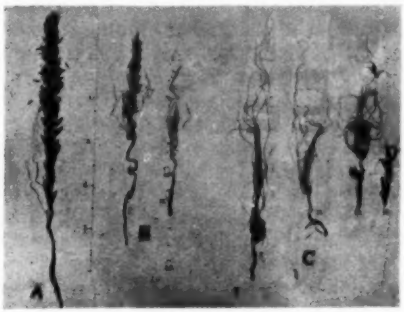
Zoological Laboratory,
University of Calcutta,
April 11, 1933.

[2] Ten Kate, 1927. "Uber das Fibrillensystem der Ciliaten." *Arch. f. Protistenk.*, **57**, 362-426.

Influence of Nutrition on Sexual Expression in Maize.

SEEDLINGS of maize grown in moist sawdust were transferred to 6″ pots containing garden soil in early January 1933. In some pots single plants were put, in others 6–8 plants in a ring and in some others 15 or more plants were crowded in together. Most of these started flowering in early April, though they had grown only to a height of 6–8″. Single inflorescences were borne terminally. Single plants in pots developed primarily male inflorescences with one or two female flowers at the base of the inflorescence (Fig. A); overcrowded plants developed female inflorescences with rudiments of male flowers at the tip sometimes, which could only be seen under a dissecting microscope (Fig. C. I–IV); and the plants which had been grown in a ring, *i.e.*, which had not been so much overcrowded usually had inflorescences in which male

and female flowers were fairly distributed—the upper region of the inflorescence bearing male flowers and the lower, female flowers (Fig. B. I–II). Thus, we find that in these maize plants, the inflorescences in single plants which had better nourishment than the crowded ones bear flowers in which maleness predominates and as more crowd-



ing takes place, maleness decreases and more female flowers begin to develop and in overcrowded pots where the plants are very much starved female flowers are only formed.

In the overcrowded pots where plants always developed terminal female inflorescences, sometimes an axillary inflorescence would also be found and the latter would also invariably be female ones though of very small size (Fig. C. III–IV).

Kashyap[1] suggested early sowings as cause of abnormalities in maize, *e.g.*, production of bisexual flowers, etc., and Schaffner[2] found maize to be decidedly influenced in its sexual expression by the length of the daily illumination period. Further experimental work on this is in progress and the complete result will soon be published elsewhere.

H. CHAUDHURI.

Lahore,
May 3, 1933.

Dispersion of Polarisation of Raman Lines.

FROM the point of view of the recent theories of the Raman Effect, it would be interesting to investigate whether the polarisation of the Raman line corresponding to a given change of frequency, depends on the frequency of the exciting light, especially when the latter approaches the absorption frequencies of the liquid in the ultra-violet region of the spectrum. Investigations made up to now on the polarisation of Raman lines are confined mostly to the visible region of the spectrum and the results are naturally not sufficient to decide the question. A convenient method of measurement applicable to the ultra-violet region has been developed by me; the polarisation of the well-known 3060 Raman line of benzene, when excited by 3125–32 lines of mercury, is found to be much less than when excited by the 4358 line.

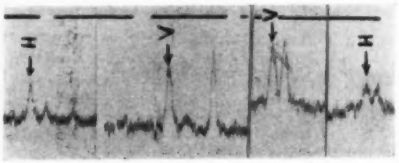
The incident light was made parallel by putting a thick block of wood provided with parallel holes blackened with dull black paint, between the mercury arc and the silica tube containing distilled benzene. No light could reach the tube except through the holes. The maximum angle made by the rays with the axis was about 7°. Photochemical decomposition was stopped by inserting a thin film of glass of special quality between the lamp and the tube and thereby cutting off the ultra-violet rays shorter than 3000 Å. The window of the fused silica tube containing the liquid was painted black, a small rectangular area in the middle being left clean. With a quartz double image prism and a lens, the two images of the aperture due to the vertical and the horizontal components of the scattered radiation were focussed on the slit of a Hilger quartz E_2 spectrograph. In order to correct the polarisation introduced by the quartz elements of the spectrograph for different wavelengths, the silica tube was removed and without disturbing the other arrangements, a small aperture in a black paper, illuminated by a quartz tungsten filament lamp, was placed in the position of that in the window of the silica tube, and the vertical and horizontal components of the continuous spectrum were photographed. All extraneous light was carefully avoided. Intensity marks were taken with the help of the tungsten lamp and by varying the width of the slit which was calibrated with a comparator. Densities were measured with the help of microphotometric records obtained with a Moll's self-registering microphotometer. The relative intensities of the horizontal and vertical components of the Raman lines and of the corresponding wavelengths in the continuous spectrum were obtained from

[1] Kashyap, Lahore. *Phil. Soc. Proc.*, 1920, p. 35.

[2] Schaffner. *Bot. Gaz.*, 1927, p. 110.

the blackening-intensity curves drawn for these wavelengths.

The microphotometric records of the vertical and horizontal components of the 3060 Raman line of benzene excited by 4358 Å and 3125–32 Å are shown in Fig. 1,



(*a*) (*b*)

Fig. 1.

(*a*) and (*b*). The line of infinite density is at a distance of 4·7 cms. from the black line. The correction factor for multiplying the observed value of ρ, due to the polarisation introduced by the quartz spectrograph is 1·0 and 0·70 for the 3060 Raman line excited by 4358 Å and by 3132 Å respectively. The vertical and horizontal components of the Raman spectrum and also of the continuous spectrum used for determining the polarisation introduced by the spectrograph for different wavelengths, are reproduced in Fig. 2.

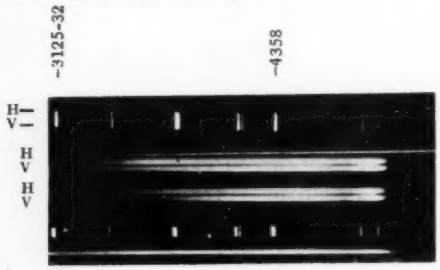


Fig. 2.

The corrected values of ρ for the 3060 Raman line excited by the lines 4358 Å and 3132 Å thus obtained are 0·61 and 0·35 respectively, the former value being almost double the latter. It may be mentioned here that these values of ρ refer in fact to two close Raman lines 3060 and 3046 which are not resolved by the spectrograph used even in the ultra-violet region investigated. (The 990 Raman line excited by the mercury line 3431 Å happens to fall exactly on the 3060 Raman line excited by 3125 Å and therefore does not affect at all the depolarisation of 3060 line excited by 3132 Å.) Details will be published elsewhere.

S. C. SIRKAR.

210, Bowbazar Street,
Calcutta,
May 4, 1933.

The Budde Effect in Iodine.

A PHENOMENON similar to the Budde Effect[1] has been observed when iodine vapour is exposed to light from a tungsten filament lamp.

The apparatus was enclosed in a furnace and pressure changes were observed by means of a glass spring manometer sensitive to 0·1 mm. The photo-expansion was proportional to the light intensity and to the pressure of iodine vapour. By means of filters it was found that at a pressure of 70 mm. the effect was most marked in the violet and orange regions of the spectrum; light of wavelength 500$\mu\mu$ having very little action.

T. S. NARAYANA.

Department of General Chemistry,
Indian Institute of Science,
Bangalore,
May 5, 1933.

A Direct Method of Feeding Plants and its Possible Applications in Agriculture and Horticulture.

IN the course of an investigation on the mechanism of synthesis of proteins in *Helianthus annus*, Linn., it was observed that the plants fed with potassium nitrate by an injection method not only tolerated high concentrations of that salt (upto 3·0 per cent.) but also showed considerable gain in dry weight (in some cases as much as 86 per cent.) over the untreated controls in the course of about three weeks. These observations being rather striking, the experiments were repeated in three successive seasons (1930-1932) with similar results.

Although injection methods have been adopted by several previous workers[2] to determine the physiological effects of various chemicals, chiefly those of poisonous nature, and to treat certain deficiency diseases like chlorosis, yet no attempt has so far been

[1] Budde, *Phil. Mag.*, **4**, 42, 290, 1871; also *Pogg. Ann.*, **6**, 477, 1873.

[2] *Vide* Rumbold, C., *Amer. J. Bot.*, **7**, 1, 1920.

made to utilize them to feed plants with various essential nutrients. The technique, as adopted in the past, has also been faulty chiefly owing to the fact that the quantities passing into the plant could not be regulated as in the case of animals. Further researches have therefore been undertaken with a view to developing simpler and, at the same time, more efficient ways of feeding plants directly with different nutrients and to study the application of such methods in (*a*) hastening plant growth and increasing crop yields, (*b*) supplying such plant nutrients and accessories to growth as the root system is unable to collect owing to adverse soil conditions, or otherwise, and (*c*) treating plant diseases, particularly those in which the root-system is already affected or the movement of nutrients therefrom to other parts of the plant is seriously impeded.

K. S. VARADACHAR.
V. SUBRAHMANYAN.
Department of Biochemistry,
Indian Institute of Science,
Bangalore,
May 5, 1933.

Preliminary Observations on Myxosporidia from India.

IT is a well-known fact that a large number of species of Myxosporidia infect fish amongst which they sometimes give rise to severe and fatal epidemics. So, with a view to make a systematic survey of this group which unfortunately is lacking from this part of the world, I examined several fish, amphibia and reptiles brought alive to this laboratory. The only previous observations on Myxosporidia from India are by Southwell[1] in 1915, on a species of Myxobolus from *Rasbora daniconius*; Southwell and Prashad[2] in 1918, on three species of Myxobolus from *Labeo rohita*, *Rasbora daniconius* and an undetermined species Sphærospora from *Barilus barna*, and Bosanquet[3] in 1910, on a species of Myxidium from *Trionyx gangeticus*. In this preliminary communication I wish to place on record several genera with hosts (not noted before from this country) of Myxosporidia from fish, amphibia and reptiles and new hosts for the genera Myxobolus and Myxidium.

Genus.	*Host.*	*Seat of Infection.*	*Locality.*
Ceratomyxa	*Fish*—		
	Gobioides rubicundus	Liver, kidney, ovary, gall bladder, etc.	Calcutta
	Trichogaster fasciatus	Gall bladder	,,
	Macrones gulio	,,	,,
Chloromyxum	Amphipnous kuchia	,,	,,
Cystodiscus	*Amphibia*—		
(=Zschokkella)	Bufo melanostictus	,,	,,
	Rana tigrina	,,	,,
	Reptile—		
	Emyda granosa	,,	Allahabad
Myxidium	*Fish*—		
	Clarias batrachus	,,	Calcutta
	Saccobranchus fossilis	,,	,,
	Ophiocephalus punctatus	,,	,,
	Reptile—		
	Kachuga smithi	,,	Allahabad
	Emyda granosa	,,	,,
	Nicoria trijuga	,,	Madras
Myxobolus	*Fish*—		
	Clarias batrachus	Ovary, liver	Calcutta
	Katla katla	Gills	,,
	Cirrhina mrigala	Liver	,,
	(Myxobolus with unequal polar capsules)		
Henneguya	*Fish*—		
	Ophiocephalus punctatus	Gills and muscles	,,

[1] Southwell, T., 1915. *Rec. Ind. Mus.*, Vol. 11.
[2] Southwell, T., and Prashad, B., 1915. *Ibid.*, Vol. 15.
[3] Bosanquet, W. C., 1910. *Zool. Anz.*, Bd. 35.

Several species belonging to these genera are new and it is hoped that detailed observations on them will soon be published.

In this connection I may add here that infection with Ceratomyxa in *Gobioides rubicundus* proved to be fatal under laboratory conditions. About 50 specimens of Gobioides were placed in a glass aquarium, water of which was changed every 24 hours. After being in this aquarium for some time, a number of specimens began to perish. Changing of water at more frequent intervals was found to be of no avail, and, by the tenth day the aquarium was empty. The first sign of death noted was that the dying ones came up to the surface of the aquarium and floated with their vent upwards. On opening their viscera it was found that almost every organ of these specimens was infected with a species of Ceratomyxa. It naturally suggests that in a running stream the chances for the spores to infect fresh hosts are not so favourable as they are in a confined area of water, and, that once the infection is taken in the parasite works the end of the host no matter how frequently the water is changed.

Pruthi[4] has pointed out that epidemic of fish mortality in the tank in the Indian Museum in 1930 was due to asphyxia. He offers same explanation for the mortality of fish in the same tank reported by Sewell[5] in 1926. Asphyxiation is possible, but at the same time, I wish to point out that the possibility of mortality in fish due to Myxosporidian infection should not altogether be ignored.

Investigations on these lines are now being carried on in this laboratory.

By this communication I also want to invite the attention of zoologists to the economic value of this type of study and earnestly request them to help me either with information or material whenever opportunity arises.

HARENDRANATH RAY.

Department of Zoology,
University of Calcutta,
April 29, 1933.

[4] Pruthi, H. S., 1932. *Internat. Revue der ges. Hydrobiol. u. Hydrographic*, Bd. 26.

[5] Sewell, R. B. S., 1926 (1927). *Jour. Asiatic Soc., Bengal*, Vol. 22.

Disarmament.

WHEN the proceedings of the Disarmament Conference were resumed, we might have almost prophesied that the delegates of the principal powers in Europe would never reach or evolve a common formula. The peace talks of Sgr. Mussolini and Mr. MacDonald and later of M. Herriot and Sgr. Mussolini and the subsequent conversations of the British Premier with President Roosevelt might have led one to hope that the time was not far off when the harassed world would witness the dawn of peace.

Hitlerism in Germany has become synonymous with Militarism. Under the guise of relieving unemployment, Herr Hitler is proposing to re-arm and train the younger generation for military service. In other words, this is a mild form of conscription and fundamentally opposed to the Treaty of Versailles.

We firmly hold that the proposals for Disarmament will never bear fruit unless the spirit of militarism and the mutual distrust, jealousies and fears are removed. They can disappear only when the European powers become thoroughly Christian in spirit and in deed.

Unfortunately, the problems of Disarmament have become complicated on account of their close relationship with those of economics and from the speeches of Mr. MacDonald and President Roosevelt it is clear that the success of the World Economic Conference depends upon an early and a speedy and satisfactory solution of the questions agitating the Disarmament Conference.

Colonel Sir Rickard Christophers, K.C.I.E., F.R.S., I.M.S. (Retd.)

By Lt.-Col. H. E. Shortt, I.M.S.

IT is one of the anomalies of Government employment that the services of an official are not infrequently dispensed with at a time when his long and varied experience has enhanced his capacity for usefulness to the point of greatest efficiency.

When this applies to a medical scientist of the calibre of Sir Rickard Christophers the loss occasioned by his retirement, both to Government and to the country which has benefited by his researches, is impossible adequately to compute. It is a trite saying that "no one is indispensable" but, in this instance, the gap left is so large that it is difficult to fill.

In a short account such as this it is impossible to do justice to the career of Christophers as a scientist and only a few salient points can be touched upon.

He received his medical education at Liverpool University, graduating in Medicine in 1896.

Shortly after this he visited South America in a private capacity but his scientific career may be said to have commenced in the year 1898. In the description given below of his activities in medical research the attempt to treat in one section each subject which he has worked at has led to some liberties being taken with chronology but, apart from this, an attempt has been made to describe his work in chronological sequence.

Colonel Sir Rickard Christophers, K.C.I.E., F.R.S., I.M.S. (Retd.)

In 1898 he was appointed a member of the Malaria Commission of the Royal Society with Professor J. W. Stephens, F.R.S. and C. W. Daniels who represented the Colonial Office.

There followed four years of intensive work on various aspects of the then new science of Malariology, a science with which, ever since, the name of Christophers has been inseparably identified and, knowing him in later years, one can imagine the ardour with which the task before the Commission was tackled by him, especially as the field was an absolutely virgin one, and not the well-trodden domain it now is.

The operations of the Commission took Christophers over a wide field, speaking both scientifically and geographically. Thus Stephens and he first commenced work in Italy (winter 1898) with Golgi and Ascoli. They then passed to British Central Africa (1898-99) where they were joined by Daniels who remained there while they proceeded to work during 1899-1900 on the West Coast (Sierra Leone, Gold Coast, Nigeria). In March 1901 Stephens and Christophers proceeded to India and continued work there until May 1902.

As the result of their studies Stephens and Christophers gave the first clear account of the conditions of native endemic malaria and all its implications. They described the African village as the reservoir of infection and the fount from which arose the malaria of travellers and expeditions. As a corollary to this they pointed out that the segregation of Europeans was the prime measure of prevention and this principle has ever since been recognized and has been the guiding principle in laying out European quarters in towns and settlements on the West Coast.

They were also the pioneers of "species sanitation" which has of recent years loomed so largely in anti-malarial work and the first clearly do demonstrate the specific behaviour of different species of Anopheles with respect to the nature of their breeding places. For this work Christophers was awarded the Wilhelmina Jubilee gold medal.

This discovery in the field was the direct outcome of antecedent work in the laboratory on the differential characters of the eggs and larvæ of different species of Anopheles which allowed of the separation of species into stream breeders, marsh breeders, pool breeders, etc. Along with this work Christophers was one of the first

to evolve a detailed classification of Anopheles and to describe the larvæ and eggs.

In 1903 appeared the first edition of Stephens and Christophers, "The Practical Study of Malaria and other Blood Parasites" which, for the time of its publication, was an extraordinary mine of information and has been an ever-present help to workers in the field of practical malaria. As evidence of its appeal to European workers it has been translated into French by the Sergents.

With Stephens and Bentley, Christophers was also one of the earliest workers on blackwater fever and experimental hæmoglobinæmia and hæmoglobinuria.

The next period of Christophers' career may be said to have commenced at his entrance into the Indian Medical Service in 1902 and to have extended up to the commencement of the Great War in 1914.

This was a period during which he accomplished an immense amount of original research work which firmly established his reputation as one of the most brilliant workers of the day in the field of medical research. In the space available it is only possible to touch on these researches as a mere catalogue, and even then only the more salient results can be referred to at all.

Malaria has always claimed much of his time and energy and has been the field of some of his most brilliant researches. He was the first to make a really scientific study of malarial epidemics as experienced in the Punjab and to point out and correlate the complex of factors concerned in these conflagrations. This work has been the starting point of all subsequent studies in this field.

In the domain of malarial entomology Christophers has been for years and is still the first authority.

In his later studies on Anopheles he again led the way in distinguishing a number of true varieties of certain species with clear geographical distributions and he is, above all, responsible for the natural classification of Anopheles based on the characters of the genitalia which is now generally adopted among entomologists. This result was only achieved after a very close and detailed study, extending over many years, of the markings and scale structure as well as of brilliant anatomical studies, all of which pointed towards the taxonomic importance of the genitalia.

More recently he has made a close study of acquired immunity in malarious communities. He commenced by studies on the spleen and parasite rates and correlated these with quantitative estimations of the numbers of parasites and the sizes of spleens in such communities. He described a definite cycle of parasitism commencing in early life with a period of acute infestation during which malarial attacks are almost continuous and lasting for two years, followed by a period of immune infestation during which malarial attacks are comparatively rare, especially in adults.

Another domain of research in which Christophers has left an indelible mark is that of kala-azar. He was early in the field and gave the first really detailed description of the pathology of kala-azar and his work on the distribution of the parasite in the human body was so minute and accurate that it was nearly thirty years before any considerable additions were made to his findings. Considering the little known of kala-azar at the time and the amount of work expended on it later this is an astounding statement to be able to make. He also gave an accurate description of the parasite as it occurs in the vertebrate host and was the first to confirm Rogers' finding of the flagellated cultural forms of *Leishmania donovani*.

One other piece of work performed by him over twenty-five years ago and which has remained ever since the only authoritative account has recently been confirmed, *viz.*, his account of the life cycle of *Babesia* in the tick. Recent researches on *Babesia bigemina* of cattle and its life cycle in the tick *Margaropus annulatus* have confirmed Christophers' early work on *Babesia canis* and its life cycle in the dog tick *Rhipicephalus sanguineus* during the course of which he worked out carefully the anatomy and histology of the tick and traced, in this connection, the hereditary transmission of *B. canis*.

In 1916 Christophers was caught up in the tide of the great war and proceeded to Mesopotamia. There he founded the Central Laboratory, Busra, and became its Director and Chief Malaria Officer to the Mesopotamian Expeditionary Force. Here he quickly showed that the scientist of the laboratory could become the practical army sanitarian, in the widest sense of the term, without any transitional stage. For over three years he directed the Central Laboratory at Busra

besides making numerous tours throughout the area of hostilities. In this laboratory he was responsible for the building up of an organization which was able to answer any scientific queries from Army Headquarters whether these related to malaria, chemistry, bacteriology, entomology, protozoology, general sanitation, food supplies or clothing.

The recrudescence of kala-azar in Assam led, in 1924, to the formation of the Kala-azar Commission financed by the Indian Research Fund Association. Of this Commission Christophers was, with unanimous approval, appointed Director and so came once more to grips with a disease with which, in the early days of its study, he had been associated as one of the chief investigators. He remained Director for over a year and, having successfully launched the Commission, laid down lines of work which subsequent experience proved to be the soundest possible.

Christophers was next appointed Director of the Central Research Institute, Kasauli, and so became the responsible adviser to the Government of India on medical scientific matters. About the same time he was honoured by being elected a Fellow of the Royal Society, a fitting reward for his services to science.

He finally retired from India in 1932, happily in the full enjoyment of health which will enable him to continue in the pursuit of those studies which have been to him a recreation rather than a burden.

As regards Christophers' outlook on science he was one of those who believed in basic research as apart from direct utilitarian research. In other words, he considered that the subsidizing of research led inevitably to the necessity for producing so-called useful results. He considered that the best and highest type of research was that done in the pure quest for knowledge without previous consideration of where the knowledge would lead and whether it would be of immediate useful application or otherwise.

Having given this altogether inadequate description of Christophers the scientist, it remains but to say a few words of Christophers the man. The last word of the preceding paragraph adequately describes him. He is a man in the best sense of the word. His humanity is so large and so all-embracing that the writer can think of no other scientific worker who was so universally beloved by all those with whom he came in contact, so that the gap left by his retirement from India is not felt in the scientific sphere alone.

This account of Christophers cannot be closed without mention of an influence the full extent of which we cannot gauge, but which he himself would acknowledge, played a great part in his successful career. Lady Christophers, beloved equally with him by all their friends in India, was to him a constant source of encouragement and both carry with them the sincerest wishes of these friends for success and happiness in their new sphere of activities.

Acknowledgments.

WE have pleasure in announcing that the Council of the Indian Institute of Science have awarded a grant of Rupees Five Hundred for *Current Science* for 1933–34. The Syndicate of the University of Madras continue their subsidy of Rupees Five Hundred for the next year. The Executive Council of the University of Nagpur have sanctioned Rupees One Hundred in response to our appeal for funds.

We take this opportunity of recording our deep sense of thankfulness to all these authorities for encouraging so readily the cause of scientific journalism in India.

With the next number of *Current Science*, the journal will complete the first year of its career. *Current Science* occupies a distinct position and fulfils a definite purpose in the scientific progress of India. We had hoped that this enterprise would receive the unstinting support of the Governments, the Universities and the enlightened public so as to relieve the financial anxiety inseparable from all such ventures. It is true that financial depression exists in the country. But we doubt the wisdom of pleading this as an excuse for withholding assistance to a journal which serves not only the interests of Science but leads the way to the general progress of the nation Viewed from this broader standpoint we have no hesitation in thinking that in the forthcoming years *Current Science* will receive the enthusiastic support of all who are placed in a position to render it, for the promotion and diffusion of scientific knowledge.

Some Obscure Aspects of Nutrition.

By N. C. Datta, M.Sc.,
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THE discoveries of the past few decades have brought to light the importance of what Mendel, in 1923, described as the "little things" in nutrition. The more recent studies on the physiologically active principles of grandular secretions and of vitamins have not only brought into prominence the rôle of various hitherto neglected entities in nutrition but have also vastly modified our ideas of dietetic requirements. There is one important aspect, however, which has not so far been properly understood and it is the object of this paper to lay stress on its significance particularly to India where the articles of diet, as also the mode of cooking, spicing and storage are different from those generally adopted in most other parts of the world.

It has long been believed that traces of various metals, particularly aluminium, copper, manganese and zinc occur regularly in the animal body but it was not until recently that their presence could be confirmed. Owing largely to want of adequate technique for the identification and analysis of minute quantities of different metals, the investigators had unfortunately long been divided in their opinion regarding the very existence of such substances in the animal body. Later work, however, has not only confirmed their presence but has also shown that they occur in varying concentrations in different parts of body, that they are present in different articles of food and that they are metabolised in the animal system in a manner similar to that of other constituents of food. Their rôle in the animal system and their relation to conditions of health and disease have, however, so far remained obscure.

During recent years, the problem has assumed an increasingly important and conspicuous position in the human environment due to the cheap production of metals and alloys and increased use of metallic containers for cooking and storage. This tendency is particularly prominent in India where even in the country-side metallic ware, particularly brass, bronze and aluminium are steadily ousting the traditional earthenware utensils and this, unfortunately, too often irrespective of the nature of food materials prepared.

In many parts of India the average diet of the people is characterised by the presence of large quantities of organic acids, particularly tartaric, citric and lactic, together with quite considerable amounts of salts, chillies and spices to buffer the taste. Dhal, vegetables or meat are cooked in such media and the preparations thus made as also various types of pickles and preserves are stored for varying periods of time in metallic vessels. Different fermentation processes, chiefly lactic, calculated to improve the taste are also allowed to proceed in metallic containers, so that the present problem, particularly in India, is not so much one of determining the role of minute quantities as that of ascertaining the consequences of taking fairly large quantities which may be reasonably expected to pass into the everyday diet of the vast population of the country.

The literature that has accumulated of recent years is not very helpful to the elucidation of the present problem. Firstly, a large part of the earlier research was directed towards determining the effect of traces, and secondly, no systematic experiments were carried out in presence of organic acids and salts and under conditions prevalent in most parts of India. The previous observations are all the same of considerable intrinsic value and some of them have been cited below to indicate the general progress in the subject.

Aluminium.—Longworthy and Austin (1904), Meyer and Voegltin (1914), Gonnerman (1918) and Bertrand (1920) have reported significant amounts of aluminium in a long list of plant and animal foods. Osborne and Mendel reported better growth in white rats from diet containing protein-free milk to which a little aluminium had been added. On the other hand, Gies and his co-workers (1916) adduced evidence to show that aluminium compounds when present in the diet are absorbed out of gastro-intestinal tract and carried into the blood stream with harmful effects. To settle the question the Referee Board of Consulting Scientific Experts of which Ira Remsen was the Chairman, studied the effect on human subjects and concluded that the residue present in biscuits baked with baking powder containing sodium aluminium sulphate has no harmful effect on metabolism.

The possible rôle of aluminium in nutrition has been recently discussed by McCollum, Rask and Becker (1928). These authors observed no noticeable difference in a period of approximately six months as regards growth, reproduction and general well-being between the controlled rats and the animals fed at a level of 0·6 per cent. of aluminium chloride. The same authors using a Hilger Quartz prism spectrograph failed to find aluminium in a number of substances in which it had been reported to be present and concluded that aluminium is not a constituent of either plant or animal matter. On the other hand, Kahlenburg and Closs (1929) using the same method reported aluminium in egg, tomato, carrot, meat and a number of other articles of food. In a like manner Wright and Papish (1929) detected aluminium in the ash of milk.

Meyer and his co-workers (1928) adduced evidence of a small but fairly constant amount of aluminium in the tissues of dog, rat and man. Meyer and Morrison fed dogs at a level of 0·23 to 1·55 g. of aluminium and found an average of 0·27 mg. of the metal per 100g. of liver as compared with 0·15 mg. of aluminium in control animals. No marked increase of aluminium was observed in any other tissue. Meyer and Mull interpret the low percentage in the tissues after prolonged aluminium feeding as indicating poor absorption.

There is abundant evidence of the occurrence of small amounts of aluminium in food and in animal tissues, but no clear-cut evidence as to whether such minute quantities have any specific function. The effect of aluminium in fairly large quantities such as obtained when preparing some Indian food-stuffs, storing pickles, curdling milk and such like operations has yet to be investigated.

Copper and Iron.—Bodansky (1921) found copper in adult brain to the extent of 3·6 to 6 mg. per kilogram of brain material. Warburg and Kerb (1927-28) have reported copper in human blood serum. McHargue (1926, 1928) states that no product of either vegetable or animal origin is free from copper. Bertrand (1920), Supplee and Bellis (1922) agree that both cow and human milk regularly contain copper and that in the case of infants as well as adults copper is absorbed from the alimentary tract as proved from its constant presence in urine. Thus, an infant three months old excretes 0·02 mg. of copper in urine, an adult on low copper diet 0·08 mg. per litre and one on high copper diet 0·11—0·14 mg. per litre.

Von Bunge was the first to show that milk is deficient in iron. Abderhalden (1900) demonstrated that animals kept on prolonged milk diet develop anæmia with marked decrease in hæmoglobin content and that increase in inorganic iron did not result in an increase of hæmoglobin content. Hart, Steenboch, Elvehjem and co-workers (1928) observed that the effect of addition of 0·25mg. of copper daily as copper sulphate and 0·5 mg. of iron as ferric chloride to a whole milk diet was immediate and striking in regeneration of hæmoglobin in rats made anæmic with whole milk diet. This is the first experiment in literature attributing to copper in association with iron the specific function of hæmoglobin regeneration in a mammal on otherwise satisfactory diet.

During the past four years, two schools of thought concerning the inorganic factor which influence the regeneration of hæmoglobin in rats made anæmic by feeding on whole milk have developed.

1. Hart and co-workers (1928), Underhill-Orten, Lewis (1931, 1932), and Keil and Nelson (1931) maintain that copper alone of all metals studied has the ability to supplement iron in curing nutritional anæmia in rats.

2. Mitchell and Schmidt (1926), Robsceit, Robbins and Whipple (1929), Drabkin and Waggoner (1929), and Meyer and Beard (1931) maintain that iron alone is effective in curing nutritional anæmia in rats though traces of other metals may have a helpful influence.

In spite of the several apparently contradictory statements on the subject, the general evidence would suggest that copper so widely distributed in the animal body and so definitely a constituent of liver must be regarded as an element of importance in iron metabolism in nutritional anæmia.

Copper taken in excess, however, has poisonous effects. Mallory announced that vegetable foods prepared in copper vessels are coloured green with copper salts and is the cause of the disease popularly known as hardening of liver. Chronic copper poisoning is a more common disease than has been thought of. Copper starts its action by causing red-colouring matter of blood to decompose forming a yellow pigment, a phenomenon which Mallory calls Hemochromatosis. Chronic copper poisoning may be slow in making itself felt but its effects,

direct as well as indirect, may be far more serious than has hitherto been suspected.

Zinc.—The occurrence of zinc in plant or animal matter seems to be nearly as general as that of aluminium, copper or manganese. Lutz estimates the total amount of zinc in the body of a man weighing 70 kilograms is about 2·2 g., *i.e.*, nearly as much as the amount of iron as estimated by Sherman (2·8 g.)

Drinker, Thompson, Marsh (1927) fed dogs and cats for periods of 3 to 33 weeks with daily doses of 175 to 1000 mg. of zinc as zinc oxide without any ill effects. Rats given from 0·2 to 3·8 mg. of zinc per day as zinc oxide grew normally and their offsprings reared successfully. The concentration of 0·038 to 0·04 mg. of zinc per gramme of tissue is maintained constant regardless of age.

Fairhill studied zinc excretion in man on ordinary diet and found the average amount passing into excretion, urine to be 1 mg. per day. The quantities passing into the fæces varied greatly, being directly influenced by the amounts ingested.

The rôle of zinc in normal nutrition has been discussed by Hubbell and Mendel (1927). These authors observe that with a supplement of 0·005 mg. of zinc per mouse per day on a diet adequate in vitamins, there was definite retardation of growth, but with 0·02 mg. of zinc per day per mouse there was better growth. Hence the authors concluded that there is a variation in growth with varying amount of zinc and that the metal is not an accidental factor in the nutrition of mouse.

Salant and his associates (1920) observed that when taken by mouth zinc is not very injurious. It is absorbed from the intestinal canal which is also the main channel for elimination. It is stored in considerable amounts in the liver.

Tin.—Moderately large doses given daily for long periods of time may prove harmful to health. The metal is rather slowly absorbed from the intestines because of the insolubility of many of its salts.

Manganese.—Manganese appears to be present in most living tissues, both animal and vegetable.

McCarrison (1927) noted that wheat was relatively rich in manganese as compared with rice and other food grains. He experimented with two groups of rats, one receiving 0·56 mg. of manganese daily and the other 0·009 mg. Both the groups of animal continued throughout in apparent good health. The group with the larger dose did not grow quite as well as the control one on adequate diet without manganese added, but the difference seemed scarcely significant. The basal diet itself contained traces of manganese.

According to Titus, Cave and Hughes (1928), the manganese-copper-iron complex is most active in hæmoglobin regeneration.

The above survey would suffice to show that very little definite information is available with regard to the rôle of different metals in either small or big doses. As the study of the effect of large doses is of considerable importance, particularly under the conditions prevalent in India, a systematic investigation of that aspect of the problem has been undertaken by the author and his co-workers. The immediate object of the study would be to determine the effect of preparing different articles of food (particularly those containing large amounts of organic acids and salts), acid drinks and butter-milk in aluminium and brass vessels (tinned or otherwise) and finally to study the effect of corrosion of the metallic cooking vessel during the preparation of different foodstuffs under conditions in actual practice in India. A parallel set of experiments under similar conditions will also be conducted to determine the quantities of metals which can be tolerated and stored in animal tissue without any harmful effect. The effect of the corresponding quantities of different metals on the growth, reproduction and general well-being of animals for several generations will also be elucidated by actual feeding experiments. It is not, however, to be presumed that a limited number of experiments conducted by a small number of workers will be sufficient to throw any definite light on this fundamental problem. It is earnestly to be hoped, therefore, that similar researches will also be undertaken in other parts of the country and elsewhere in the world under conditions prevalent in different areas so that, at the end of a certain period, the various observations may be pooled together and some definite conclusions drawn. The organization of such a research on a large scale basis would indeed be difficult, but in view of its fundamental importance it is hoped that the Indian Research Fund Association as also International Organizations like the Rockefeller and the Carnegie Foundations would take interest in the problem and render the necessary moral and material assistance.

With such efficient organization on the one hand and keen public interest in the progress of the researches on the other, it is not too much to hope that before long some fundamental conclusions leading to the evolution of newer and more balanced dietetic schemes and further betterment of public health would be reached.

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Atomic Nucleus and the Hyperfine Structure of Spectral Lines.*

By Prof. B. Venkatesachar, M.A., F.Inst.P., *Central College, Bangalore.*

THE end of the nineteenth century saw the climax of what is to-day known as Classical Physics. The work of Maxwell and Faraday and Fresnel and Young based on the foundations laid by Galileo and Newton appeared to be a splendid structure almost without a flaw. However, there were a few misfits, like the distribution of energy in the spectrum of a black body, which troubled master-minds like Kelvin and Rayleigh. The brilliant theory of Planck, advanced in 1901, questioned for the first time the foundations of classical physics and the photo-electric equation advanced by Einstein jeopardized the whole structure.

Meanwhile, a large amount of experimental knowledge was being collected by improved experimental technique. The structure of the atom had been engaging the attention of the leading physicists and Thomson had propounded his theory that the atom is constituted of electrons imbedded in a spherical positive charge. Rutherford's experiments on the scattering of α-particles established the fact that the α-particles could pass through atoms and suffer large deviations, and this led to his famous nuclear theory of the atom. In 1913 Bohr formulated his celebrated theory of the hydrogen atom, attributing to the revolving electron angular momenta which were quantised and thus restricted the possible orbits. Soon after, he explained the spectrum of ionised helium and showed how the differences in frequency between the helium lines and the alternate hydrogen lines could be explained by taking into account the fact that the mass of the electron is not negligible compared to that of the nucleus. Bohr thus brought order into a large mass of empirical data regarding the emission lines of hydrogen and helium. Sommerfeld extended the theory by including elliptical orbits, thus attributing two quantum numbers, azimuthal and radial, to any orbit. The relativity variation of the mass of an electron in an elliptical orbit due to varying speed in the orbit was found to explain the fine structure of spectral lines.

One important corollary from Bohr's theory was that by exciting the atoms or molecules and thus raising the ground-level electrons to higher states of energy, absorption of lines not absorbed by the normal vapour could be effected by the incidence of the suitable light quantum. This important conclusion has been verified by the experiments of Metcalfe and Venkatesachar (*Proc. Roy. Soc.*, **A 100,** 149, 1922 and **A 105,** 520, 1924) who showed large selective absorption in mercury vapour by the device of double arcs, one very weak and long and the other very strong, the latter acting as the source.

A very large amount of work has been accomplished in the study of the emission spectra of various elements. It must be remembered that these lines result from the various ways of internal arrangement of the loosely bound or valence electrons. Also we must distinguish the emission spectra of neutral atoms from those of singly ionised or multiply ionised atoms. In the case of the alkali elements, for example, there is only one valence electron and the study becomes simpler. The total quantum number (n) of this electron orbit in the lowest state is 3. There are three more quantum numbers associated with the electron: l (which is always equal to $k-1$, where k is the azimuthal quantum number), s, the spin quantum number and j which is $l \pm s$ (*i.e.* $l \pm \frac{1}{2}$

* Summary of six lectures delivered at the Annamalai University, Annamalainagar.

for the one electron system we are here contemplating). In the case of an atom having any number of valence electrons, the *l*'s of the several electrons are vectorially combined into a resultant L and the spins into a resultant S and J is obtained as the resultant of L and S. In the presence of a uniform external force field, each electron is characterized by five quantum numbers, *viz.*, n, l, s, m_1 and ml. According to the celebrated theoretical physicist, Pauli, these five quantum numbers cannot be identical for two or more electrons; this assumption gives a natural explanation of the short and long periods in the periodic table.

With improved experimental technique, spectroscopists soon found that the several lines of a multiplet whose origin is usually attributed to electron spin showed a hyperfine structure, the separations herein being much smaller than those due to the spin of the extra-nuclear electrons. For the experimental study of the hyperfine structure of elements like cadmium, cæsium and thallium, the method described by Venkatesachar can be adopted. The cathode in the vacuum arc is a 2% amalgam of the element. By cooling the arc, the lines may be obtained extremely sharp and without self-reversal.

Very great care has to be exercised in the experimental technique; otherwise, spurious results may easily occur. The line width of the satellites has to be arranged to be small enough so that separations can be observed easily. It has been shown by Venkatesachar (*Phil. Mag.*, **49**, 33, 1925) that the half-width of a line $w = \sqrt{\frac{\log 2}{k}}$ where $k = \frac{M}{2R\theta}\frac{c^2}{\lambda^2}$. It follows that w can be greatly reduced by decreasing θ, *i.e.*, by working at very low temperature, *e.g.*, by using liquid air around the cathode. By using long columns, the relatively greater absorption of the central parts of the satellites will result in their widening and thus decrease the resolvability of two neighbouring lines. This might even result in a self-reversal along the middle of the line. Such was indeed found to be the case with electrically excited cadmium vapour for 4800 Å. However, long columns are useful in the study of weak lines which are not markedly absorbed. The Lummer-Gehrcke plate is most frequently used in the study of the hyperfine structure of spectral lines. There is the danger of the appearance of ghosts even in the best-made plates and special care has to be taken to distinguish the true from the false lines. Fused silica etalons have also been recently used in the study of hyperfine structure and Venkatesachar and Sibaiya (*Jour. Sc. Inst.*, **9**, 216, 1932) have shown their advantages particularly in the observation of faint satellites.

The usual theory advanced for the hyperfine structure is that the nucleus of the atom has a quantised rotation with a quantum number i which, with the inner quantum number j, gives fine quantum numbers of the sub-levels ranging from $j + i$ to $j - i$. The selection rule laid down by Hargreaves suggests that during a transition this quantum number changes by 1 or 0. Ruark and Chenault have suggested that the small quantised variations of the configurations of the outer shells cause small changes in the energy levels of the valence electron. Schüler and Brück postulate the existence of zero moment in the case of even atomic weights and ½ in the case of odd atomic weights amongst the isotopes of cadmium.

When the magnetic moment of the nucleus is deduced from the magnitude of the hyperfine separations it comes out to be of the order of 1/2000 of a Bohr magneton. This fact suggests the annihilation of electron spin within the nucleus. A good part of this difficulty, however, can be overcome if we assume with Venkatesachar and Subbaraya (*Current Science*, **1**, 120, 1932) the existence of only α-particles, protons and neutrons within the nucleus.

"A large amount of work yet remains to be done. The theory of hyperfine structure is still in its infant stage and the subject offers the greatest scope to all investigators, not only from the point of view of the difficult experimental technique involved but also from the fact that a thorough knowledge of the complicated structure is necessary for a correct understanding of the most fundamental problems of modern physics."

The World Economic Conference.

ON the 16th of June about 2,000 delegates drawn from all countries will meet in London to discuss the economic problems which now confront every nation and seem to challenge a satisfactory solution. We are satisfied about the representative character of this large assembly and considering the magnitude and the intricate complexities of the issues that will come up for discussion, we venture to doubt whether in the multitude of counsels any satisfactory formulae will be evolved. The world suffers now not so much from want of agricultural produce or manufactured goods but curiously from an excess of both, and the marketing facilities have been restricted by high tariffs and narrow protectionist policies. The removal of any of these alone, even if it is possible, may not alleviate the economic depression; for vested interests and capitalism are not likely to be removed at one or even a series of sittings of economic conferences. Perhaps a smaller body of scientists, industrialists and bankers would be able to deal with these problems in a more efficient, and possibly, in a permanently satisfactory manner than a large concourse of politicians can hope to do. Scientists possess both knowledge and executive power which, when supplemented by the practical experience of economists and financiers, will become a power for the removal of all those ills with which the social and economic life of the nations is afflicted. However, we hope that the efforts of the Economic Conference for the spread of peace and contentment in the world will be crowned with success.

Research Notes.

Line Groups and Fine Structure.

[F. Paschen, *Ber. d. Preuss. Akad. d. Wiss*, **32**, 3, 1932.]

IN this paper Paschen considers the effect of hyperfine structure on the lines of a multiplet when the hyperfine separation is of the same order of magnitude as the gross multiplet separation. The effect is shown to be similar to the Paschen-Back magnetic transformation of a multiplet, but here the magnetic field is provided by the nuclear spin. Accordingly, the positions and intensities of the multiplet lines are disturbed and forbidden transitions belonging to the multiplet are produced; since each of the multiplet lines is also split on account of the hyperfine structure, the whole group of lines shows a structure which is due neither to simple gross multiplet separation nor to pure hyperfine separation of the multiplet lines. In this way the unaccounted doubling of the levels in the spectrum of Al II which Paschen had previously discovered is explained. Multiplets are also considered in which the hyperfine separation predominates over the fine separation, *e.g.*, the $4^3P_{2,1,0}$—5^3D_j group in Al II. It is shown that in this case the j value of the 5D term is not determinable since the term acts as a $^3D_3$ term in its combination with $^3P_2$ but behaves like a $^3D_2$ term in its combination with $^3P_1$. From these observations as well as the experiments of Ritschl, Paschen concludes that the Al nucleus has a spin of $\frac{1}{2}\frac{h}{2\pi}$. The displacement of the components of the hyperfine structure pattern of λ 5791 found by Schüler and Jones is also to be explained according to Paschen on the above lines since here the difference between $^3D_1$ and $^1D_2$ of Hg I is only 3 cm.$^{-1}$ while the hyperfine separation of the levels is about $\frac{1}{4}$ of this. The appearance of the forbidden transitions $6s\ 6p\ ^3P_0$—$6snd\ ^1D_2$, $n=6, 7, 8$ in Hg I is also accounted for as an effect of the nuclear moment. A continuation of these investigations is also promised.

Nitrogen Recuperation in the Soils of the Bombay Presidency.

[Part III. By D. L. Sahasrabudhe and N. V. Kanitkar. *Ind. J. Agric. Sci.*, **2**, 455, 1932.]

THE above is the third of a series of contributions by Sahasrabudhe and his co-workers to a problem of fundamental importance not only to Deccan but also to the rest of the world in general. The authors claim to have obtained definite evidence of nitrogen recuperation on the dry farm tracts which they investigated. The recuperation is facilitated by (1) wetting by monsoon followed by dry weather, (2) better cultivation, and (3) addition of organic matter in the form of farm-yard or green manure. Soil moisture and temperature are important factors determining the efficiency of the process, the optimum conditions being 20 per cent moisture and 30° C. The authors conclude that the nitrogen content of the soil is not a stable or constant quantity. There is a range for every soil which is determined by various factors, such as, moisture, temperature and aeration, which, again, are dependent on the prevalent climatic conditions.

The paper is unfortunately defective in some respects. Thus, no mention is made of the errors of (1) random sampling from the experimental area, and (2) analytical methods employed. It is not clear from the text as to how many specimens were analysed at a time but the results would have been far more valuable if the different representative samples had been analysed independently instead of being mixed together. It is hoped that the above defects will be eliminated in later publications.

Double Hydropore in the Development of *Asterias glacialis*.

IN this paper Dr. N. Narasimhamurti (*Journ. Exp. Biol.*, **10**, No. 2, 1933) observes that the addition of sodium chloride to the sea-water in the proportion of 38 grms. per 1000 cc. produces double pored larvæ of *A. glacialis* in greater numbers than is the case in ordinary laboratory cultures. The author is of the opinion that this increase in the number of abnormal larvæ in the hypertonic cultures is the result of the addition of salt, quite early in the development and that it acts as a stimulus to the growth of the larvæ equalising the difference between the right and left larval halves thus producing a right hydropore.

A New Method of Producing Extremely Low Temperatures.

(F. Simon. *Physikal. Zeitschr.*, **34**, 232, 1933.) IN the reports of the Proceedings of the Thüringian-Saxonian section of the German Physical Society which met at Breslau on the 8th and 9th January 1933 a new method of producing liquid helium is described. The principle is extremely simple. A small vessel filled with helium at about 100 atmospheres pressure is cooled to about 11° Abs. by means of solid Hydrogen and then is thermally isolated from the surroundings; the helium is now allowed to escape through the inlet itself. The work done in the expansion cools the helium so that about 60% of it becomes a liquid and remains in the vessel. The method is so simple that it could be easily demonstrated before the meeting. In the discussion that followed it was suggested that by demagnetising gadolinium sulphate, even 0·1° Abs. might be reached whereas the lowest temperature reached by evaporating helium was 0·7° Abs. (Keesom, 1932). Further details of the method are to be published in the *Zeitschrift für Physik*.

Production and Hatchability of Eggs as affected by different kinds and quantities of Proteins in the Diet of Laying Hens.

[By T. C. Byerly, H. W. Titus and N. R. Ellis. *J. Agric. Res.*, **46**, 1933. 1.]

THE above has been the subject of a number of previous researches, but the present authors would appear to be the first to obtain quantitative data in support of their conclusions. The results bring into relief the following—(1) feeding with meat, fish, crab or butter-milk as the source of protein led to not only more intensive egg production but also better hatching than that with grains and vegetables; (2) increasing the percentage of protein in the diet within limits of 11·2 and 23·6 augmented egg-production by increasing (*a*) intensity of production, (*b*) average egg-weight, and (3) diets containing vegetable proteins only increase the incidence of chondrodystrophy in the embryos of hens. Embryos in eggs from such hens had also a high second-week mortality.

The above results would suggest that there was some fundamental deficiency in the vegetable proteins tried by the authors. It would be of interest to extend their observations to different other forms of vegetable and animal proteins and to determine the precise chemical nature of the deficiency leading to chondrodystrophy in chicken.

Habits, Structure and Development of *Spadella cephaloptera*.

IN this excellent paper Mr. C. C. John (*Q.J.M.S.*, Vol. **75**, Part 4, 1933) has endeavoured to bring together a great deal of information relating to the structure and development of *Spadella cephaloptera*, a Chætognath. The work is all the more welcome in the field of zoology as no previous description of either development or habits has been satisfactory and as there are only a few scattered references to points of structure.

Several important points have been discovered with regard to the habits and structure. It is interesting to note that Spadella reproduces all the year round and that it can withstand reduced salinity and thus is pre-eminently adapted to life in bays and sounds in the mouths of rivers. The structure and function of the cement glands the secretions of which form a covering round the eggs are described for the first time. The corona ciliata which hitherto was supposed to be olfactory in function is experimentally proved to be a tactile organ. With regard to the nervous system it is noticed that the position of the vestibular ganglion and its nerves in Spadella is different from that in the allied genus Sagitta. There is a detailed account of the musculature and the chapter on reproduction is extremely interesting. The ovary is described as opening directly into the dorsal part of the seminal receptacle whereas in Sagitta there is a double duct along the outer side of each ovary opening posteriorly at the level of the rectum into the seminal receptacle. There is in Spadella a distinct tube called vagina. In the chapter on development the general account of the sequence of early embryonic stages previously based on a study of whole mounts has been verified with sections. It is remarkable that though the egg contains yolk, cleavage is regular owing to its uniform distribution. The germ cells which originate before the formation of archenteric folds are observed to separate into the distinct ovary and testis by the formation of the secondary septum which is mesodermal in origin. The hood is shown to develop as a lateral fold

on each side and not by a splitting of the lateral ectoderm as recorded by Doncaster in his paper on Sagitta. The male duct in Spadella is formed partly from the ectoderm and partly from the endoderm. In conclusion, it can be said that the paper constitutes an excellent monograph which is sure to become classical as it fills a gap in our present knowledge of the phylum Chætognatha.

The Element of Atomic Number 61.

[Maurice Curie and S. Takvorian. *Comptes Rendus*, **196**, 923, 1933.]

THE discovery of the radioactivity of Samarium has been recently announced by Hevesy and Pahl (*Nature*, **130**, 846, 1932) who suggest that this activity may be due to the presence of the element of atomic number 61. Libby and Latimer have confirmed the fact that Sm is radioactive and they also suggest that Nd and La are also possibly radioactive.

The authors measured the activity of different fractions obtained when a mixture of oxides of Nd (atomic number 60) and Sm (62) containing some La and Pr and obtained from Indian Monazite was being separated by fractionation according to the method of G. Urbain. They used a very sensitive Wulf electrometer to measure the activity and found that within the limits of sensitiveness of their apparatus Nd and La do not show any radioactivity. Sm was shown to emit a very easily absorbed radiation which could not be attributed to element No. 61. There was, however, a more penetrating radiation which showed a maximum of intensity in that sample in which element No. 61 was expected to be most abundant. The penetrating power of this radiation was too large for it to be a stream of α-particles. These interesting researches are being continued.

Effect of Dairy Manufacturing Processes on the Nutritive Value of Milk—The Apparent Digestibility of Fresh Whole Milk and of Powdered Whole Milk.

(*Journ. of Nutrition*, **6**, 139, 1933.)

FEEDING experiments with albino rats have shown that the apparent digestibilities of total protein, fat, sugar and total solids present in fresh whole milk and powdered whole milk as prepared by the spray or roller process are very nearly the same. There is no experimental evidence to suggest that any one type of preparation is more completely digestible than the others. There is an indication, however, that there is variation between individuals with respect to their tolerance for certain preparations so that sometimes fictitious impressions with regard to relative total nutritive values are obtained.

The above observations are of much interest though further experiments with human subjects will be needed before any definite conclusions can be drawn. Investigations of this type have already been carried out elsewhere with school children and it will be of much practical importance if further researches can be organized with the co-operation of a number of residential institutions and under the guidance of a competent body of doctors and statisticians.

The Most Probable Values of e and h.

[R. Ladenburg, *Ann. d. Physik*, **16**, 468, 1933.]

KIRCHNER (*Ann. d. Physik*, **13**, 59, 1932) assumed that the short wavelength limit of the Röntgen spectrum measured by a line grating was more accurate than that obtained by means of a crystal; using the value of $\frac{h}{e}$ so obtained and the value of $\frac{h}{e^{5/3}}$ deduced from the Rydberg constant and the value of $\frac{e}{m}$ obtained by himself, he calculated the values of e and h as follows:—

$$\begin{cases} \frac{e}{mc} = (1{\cdot}7585 \pm 0{\cdot}0012) \times 10^{7} \\ \qquad\qquad \text{(Kirchner's value).} \\ R_{\infty} = 109737{\cdot}4. \quad e = 2{\cdot}9981 \times 10^{10}. \end{cases}$$

Hence $\frac{h}{e^{5/3}} = (2{\cdot}2491 \pm 0{\cdot}0005) \times 10^{-11}$

$\frac{h}{e}$ (Measurement of Duane and his co-workers) $= (1{\cdot}3787 \pm 0{\cdot}0008) \times 10^{-17}$.

$\frac{h}{e}$ (Feder's value) $= (1{\cdot}3755 \pm 0{\cdot}0008) \times 10^{-17}$.

Hence $e = (4{\cdot}798 \pm 0{\cdot}006) \times 10^{-10}$,
$h = (6{\cdot}615 \pm 0{\cdot}012) \times 10^{-27}$
and $e = (4{\cdot}782 \pm 0{\cdot}006) \times 10^{-10}$,
$h = (6{\cdot}577 \pm 0{\cdot}012) \times 10^{-27}$.

Now Millikan's value of e is $4{\cdot}770 \pm 0{\cdot}005$. Accordingly, Ladenburg considers the above values of e as too high and calculates a more probable value as follows:—

From the photo-electric effect, according to Lukirsky and Prilez'aev,

$$\frac{h}{e} = (1{\cdot}3716 \pm 0{\cdot}0014) \times 10^{-17}.$$

From measurement of ionization potential of Hg by electron impact, according to Lawrence,

$$\frac{h}{e} = (1{\cdot}3752 \pm 0{\cdot}0027) \times 10^{-17}.$$

From the radiation constant c_2,

$$\frac{h}{e} = (1{\cdot}3728 \pm 0{\cdot}0030) \times 10^{-17}.$$

Mean $\frac{h}{e} = (1{\cdot}3728 \pm 0{\cdot}0011) \times 10^{-17}$.

These values show that the measurements with the line grating are unreliable.

$\frac{e}{m}$ (Kirchner) $= (1{\cdot}7585 \pm 0{\cdot}0012) \times 10^{7}$,

$\frac{e}{m}$ (Houston) $= (1{\cdot}761 \pm 0{\cdot}001) \times 10^{7}$,

$\frac{e}{m}$ (Perry and Chaffee) $= (1{\cdot}761 \pm 0{\cdot}001) \times 10^{7}$,

$\frac{e}{m}$ (Campbell & Houston) $= (1{\cdot}7579 \pm 0{\cdot}025) \times 10^{7}$.

Hence mean $\frac{e}{mc} = (1{\cdot}760 \pm 0{\cdot}0006) \times 10^{7}$.

Therefore $\frac{h}{e^{5/3}} = (2{\cdot}2486 \pm 0{\cdot}0003) \times 10^{-11}$ which differs very little from Kirchner's value, $(2{\cdot}2494 \pm 0{\cdot}0005) \times 10^{-11}$.

Thus $e = (4{\cdot}770 \pm 0.006) \times 10^{-10}$.

Combining this with Millikan's value, *viz.*, $(4{\cdot}770 \pm 0{\cdot}005) \times 10^{-10}$ the most probable value of e is found to be

$$e = (4{\cdot}770 \pm 0{\cdot}004) \times 10^{-10}$$

and hence $h = (6{\cdot}547 \pm 0{\cdot}009) \times 10^{-27}$.

Ladenburg concludes that the crystal measurements are correct while the line grating measurements are affected by some unknown error.

Using the above values, Ladenburg obtains

$$\frac{1}{\alpha} = \frac{ch}{2\pi e^2} = 137{\cdot}307 \pm 0{\cdot}048.$$

This differs materially from Eddington's theoretical value $\frac{1}{\alpha} = 137$.

Spermatogenesis of the Mouse.

PAUL R. CURTRIGHT of the University of Pittsburg has recently published a paper (*Journal of Morphology*, Vol. **54**, No. I, December 5, 1932) on the Spermatogenesis of the Mouse (*Mus musculus*, var. Albula) and confirms the diploid number of chromosomes to be forty. The number has been verified in the spermatogonia and the somatic cells of the mouse embryo. A continuous spireme is not present in the spermatogonia but elongate leptotene threads develop early in the prophase. There is no evidence of a 'bouquet' stage at any time. The sex chromosomes are of the X and Y type and are shown to exist early in the growth period. The X chromosome is a relatively short, three chromomered structure and the Y a shorter two chromomered one. The bivalents are of varied shapes and the union of the bivalents during diakinesis is very intimate. During diakinesis union takes place between corresponding chromomeres and this affords significant evidence of the allelomorphism of the chromomeres in the mammals. A chromosome nucleolus in the spermatocyte whose presence distinguishes the spermatogonial nucleus from that of the spermatocyte divides at the time of diakinesis and the divided portions which are equal in size are interpreted as the largest pair of autosomes. The haploid number of twenty is verified in both primary and secondary spermatocytes.

The Blood Circulation of Animals possessing Chlorocruorin.

H. MUNRO FOX (*P.R.S.*, **B 779**, Vol. 112) has described a series of very interesting experiments on the blood vascular system of Sabellids and Serpulids possessing chlorocruorin. The author, however, has not restricted himself to the polychætes but has also experimented on chick, crustacea and molluscan embryos with reference to reversible inhibition due to CO_2. He points out how the circulation of blood is rhythmic and is not under the control of the central nervous system. After the retreat of these worms into the tubes the pulsation in the vessel ceases. Spirigraphis is noted to live uninjured in such state for 8 hours after which it makes a fresh opening and comes out. Curiously, however, when these polychætes are placed in sea water whose pH is below 6·0, the contractions of the vessels stop. Possibly this cessation of pulsation is due to the accumulation of CO_2 in the tube when these animals contract.

Obituary.

Lt.-Col. A. W. Alcock, C.I.E., F.R.S.

1859-1933.

THE sad and sudden death of Colonel A. W. Alcock will be deplored by his large circle of friends and admirers throughout India.

Alcock was educated at Millhill, Blackheath, and Westminster, and after graduating as a zoologist served for about two years as an Assistant Professor of Zoology in the University of Aberdeen under Professor H. A. Nicholson, F.R.S. He passed the competitive examination for the Indian Medical Service and served as a medical officer with the Punjab Frontier Force from 1886-88. He was then selected for the post of the Surgeon-Naturalist to the Marine Survey of India in 1889. In 1892 he served for a short period as the Deputy Sanitary Commissioner, Bengal. On the retirement of Mr. J. Wood-Mason, Superintendent of the Indian Museum, in 1893, he was appointed to succeed him and served in this capacity till his retirement in 1907. He also acted as the Professor of Zoology in the Medical College, Calcutta, during his tenure as the Superintendent of the Indian Museum. In 1895 he accompanied the Pamir Boundary Commission as a Naturalist. After his retirement from India he worked as a Lecturer in Medical Entomology in the London School of Tropical Medicine, and in 1919 was appointed the Professor of Medical Zoology in the University of London. He retired from the latter post in 1924.

Col. Alcock was a very distinguished zoologist and from 1890 to 1907 he published nearly 50 papers on Marine Zoology of India. His systematic papers include accounts of Anthozoa, Echinodermata, Brachiopoda, Mollusca, Crustacea and Fishes. Amongst these contributions those on deep-sea fishes and crustacea deserve special mention. The series of papers entitled "Materials for a Carcinological Fauna of India" published in the *Journal of the Asiatic Society of Bengal* from 1895-1900 and in which he critically treated most of the marine families of Brachyurous Crustacea, are a rich mine of information and are indispensable to every worker in Carcinology, and particularly to workers on Indo-Pacific forms. His Catalogues of Decapod Crustacea and deep-sea fishes in the Indian Museum similarly contain very comprehensive accounts of the rich crustacean and fish faunas of the Indian seas. In 1910 Col. Alcock published a valuable memoir on the Potamonidæ, or the freshwater crabs of India. In addition, he published a number of papers on such diverse subjects as Viviparous Fishes, on an Instance of Natural Effect of Warning Colours, on the Toxic Properties of Saliva in certain Colubrine Snakes, on a New Flying Lizard from Assam, and on a New Apodous Amphibian from India. His masterly memoir on the Classification of the Culicidæ with particular reference to the Constitution of the Genus Anopheles published in 1911 laid the foundation of our present knowledge of the subject, and about the same time he performed an even greater service to tropical zoology by the publication of his very lucid text-book entitled "Entomology for Medical Officers".

Col. Alcock's work as the Superintendent of the Indian Museum also has to be specially considered. Alcock was almost the first zoologist to carry out original zoological research of a high order in the Indian Museum, Calcutta, and under very difficult conditions he carried out reforms of an outstanding nature in the general management of this institution, while his work in connection with the preparation and arrangement of the exhibits in the various public galleries of the Museum was particularly valuable. To popularise the Museum and make it possible for the lay public to understand the exhibits in the Indian Museum Col. Alcock wrote a series of very interesting and handy guide-books of the various galleries under his charge. Reference may also be made to the popular account of his work as a Naturalist on R.I.M.S.S. "Investigator", published in that delightful work entitled "Naturalist in Indian Seas" in 1902.

Col. Alcock's work on Marine Zoology of India earned for him the Honorary degree of LL.D. from the University of Aberdeen in 1904, while he was elected a Fellow of the Royal Society of London in 1901. He was awarded the Barclay Memorial Medal by the Asiatic Society of Bengal in 1907. He was a corresponding member of the Zoological Society of London, and of the Netherlands Zoological Society, and an Honorary Member

of the California Academy of Sciences, Philadelphia. He was elected an Honorary Fellow of the Asiatic Society of Bengal in 1911 and his services in the Indian Museum were recognized in 1903 by the grant of the title of C.I.E. B. P.

Science News.

Aneuploidy in the genus "Cassia".—MR. R. M. DATTA, Department of Botany, Presidency College, Calcutta, writes:—Aneuploidy unlike polyploidy, is not a very common phenomenon in the Angiospermous plants, and only in a very few genera, such as *Datura*, *Œnothera*, *Triticum*, *Vicia* and others, has this been recorded. It appears that as far as the leguminous plants are concerned, aneuploidy has been reported only in the genus *Vicia*; but this phenomenon is also seen in the genus *Cassia* of the same family. Saxton found *n* 12 chromosomes in *Cassia tomentosa*; Tischler recorded the same haploid number for *Cassia fistula*. Muto obtained *n* 13 chromosomes in *Cassia occidentalis* while Sethi reported *n* 14 in *Cassia didymobotrya*. The present writer records *n* 13 for *Cassia tora* and recently Ghose and Alagh record *n* 10 in *Cassia purpurea*. Thus so far as this genus has been cytologically studied the *n* chromosomes appear to be 10, 12, 13 and 14, the common numbers of haploid chromosomes for the family Leguminosæ being 6, 7, 8, 10, 11, 12, 13, 14, 16 and 24.

* * *

MR. P. M. GANGULI, Botanical Assistant, Assam Department of Agriculture, describes a method of crossing work in rice (*O. sativa*) in which he states nearly 90% success has been obtained. The process described by him is the same as that adopted by Sarangapani (1924) in the *Agricultural Journal of India*, with this difference, that instead of tying the glumes with fine silk, he has used rubber rings cut out of cycle valve tube to close the glumes which generally tend to remain open after emasculation.

* * *

Sixteenth Session of the International Geological Congress:—The third circular for the sixteenth session of the International Geological Congress, which is to meet in Washington, U.S.A., from July 22 to 29, has been issued. It contains full information about meetings and about excursions, with costs. Before the Congress there are excursions to various parts of the Eastern United States, lasting from 4 to 12 days, and a transcontinental excursion eastward from San Francisco for those coming to the Congress from the West. For those arriving at New York too late to take part in these longer excursions there will be a number of short trips to nearby areas of geologic interest. Alternate days during the sessions of the Congress will be given to excursions to areas around Washington. After the sessions, there will be two longer transcontinental excursions, each lasting 31 days, and two shorter excursions, one for the study of the glacial geology of the Central States, the other for the study of the pre-Cambrian area, including the iron and copper deposits, of the Lake Superior region. In order to make these excursions generally available, it has been possible, through the generous assistance of the Geological Society of America, to offer the longer excursions at a considerable reduction below actual cost.

For special discussion at the scientific sessions in Washington the following topics are announced:

Measurement of geologic time by any method.
Batholiths and related intrusives.
Zonal relations of metalliferous deposits.
Major divisions of the Palæozoic era.
Geomorphogenic processes in arid regions and their resulting forms and products.
Fossil man and contemporary faunas.
Orogenesis.
Geology of petroleum.
Copper resources of the world.

Membership in the Congress is open to anyone interested. A copy of the third circular and other information can be had from W. C. Mendenhall, General Secretary, U. S. Geological Survey, Washington, D.C.

* * *

At the Ordinary Monthly Meeting of the Asiatic Society of Bengal, held on Monday, the 1st May, 1933, Dr. S. L. Hora read a paper on Mud-fishing in Lower Bengal.†

With the change of seasons in India, the methods of fishing also change. During the rainy season, when the country is flooded, the waters run high in rivers and streams and stand deep in pools and ponds. At this time of the year the fish are rather difficult to catch, and cast-nets and other types of nets are used to collect them. With the beginning of the dry season, the waters begin to fall and the fishes are restricted more and more to shallow, confined waters, where they are liable to be easily netted or even caught by hand. The term mud-fishing is used in connection with several ingenious devices for catching fish in the dry season by hand in almost semi-liquid mud. In his paper the author has described four such methods of fishing and the kinds of fish and crustacea obtained by these methods are enumerated.

The biological significance of this study is that it reveals the great adaptability of several of our commoner species to highly adverse conditions of existence. There are two important ecological factors which an animal association living in pools and puddles in Lower Bengal has to contend with, namely, the variation in the salinity of water due to floods and evaporation: and secondly the rapidly decreasing quantity and final disappearance of water during the dry season, and the consequent lack of facilities for aquatic respiration. The present paper deals only with the methods of fishing, while biological notes on the catch are reserved for a subsequent communication.

Mr. M. S. Mani then showed an exhibit of a Gall-section showing Cyst Formation and spoke thus:—

"While investigating the response of the vegetable tissues to the stimulus from the gall-makers, it was observed that the stimulus was simultaneously of a mechanical, physical, and chemical nature. The response of the plant was found to be a kind of resistance to the changes brought

†The following is from the Society's Proceedings.

about by the enzymatic secretions of the gall-maker. Thus it is known that in oak galls the plant produces tannin. The gall-makers produce diastase and invertase, which destroy plant cells. These substances are themselves precipitated by tannin and rendered powerless. The gall-maker produces, in addition, tannase and other oxidizing enzymes. Tannase hydrolyses tannin to gallic acid, so that the two cell-dissolving enzymes, diastase and invertase, are not precipitated. The gallic acid changes to pyrogallol which is oxidized by the oxidising enzymes to purpurogallin, so that at every phase the plant responds to various changes, though at last overcome by the gall-maker. In some cases of attack of parasitic fungus, the cells are rapidly suberized just in front of the fungal hyphæ, so as to place a kind of barrier in the way of the attacking foe. A somewhat similar adaptation to changing conditions was noted in certain entomocecidia also. The enzymes secreted by the Itonid larva were found to give rise to suberization of cell walls. The cells surrounding the tunnel occupied by the Itonid become thickly suberized and thick-walled. In the slide exhibited here, a transverse section is mounted of the solid-stem gall of *Pongamia glabra* Vent. Embedded in the parenchyma may be seen a large circular hole, the larval tunnel. This is surrounded by several concentric layers of thick-walled cells, the suberized ones. A hard fistular structure made up of these thick-walled cells encloses the Itonid larva. The larva appears as if it were encysted in the flesh of the gall and on this account the name cyst has been given to the tubular structure. The cyst appears to act as a kind of barrier to the irritant activity of the Itonid, so that after suberization and cyst-formation, active cell-proliferation is nearly brought to a standstill and the gall practically ceases to grow. This curious phenomenon will be further explained."

* * *

The Registrar, University of Madras, Triplicane P.O., Madras, writes :—

"The Ramanujam Memorial Prize," of the value of Rs. 500, will be awarded for the best essay or thesis written on any branch of Mathematics, embodying the result of the personal investigations of the author and containing clear evidence of independent and original research. The prize is open to all persons born or domiciled in India. Intending competitors should forward the manuscripts so as to reach the Registrar *not later than the* 1*st December* 1933."

* * *

At the 12th Annual Meeting of the Indian Botanical Society held at the Science College, Patna, on the 3rd January with Dr. S. L. Ghose in the Chair, Dr. D. H. Scott, F.R.S., and Prof. F. O. Bower, F.R.S., were unanimously elected Honorary Members of the Society. The following were elected Office-Bearers for this year: *President*:—Prof. S. P. Agharkar. *Vice-Presidents*:—(1) Dr. T. Ekambaram, (2) Prof. J. H. Mitter. *Secretary*:—Dr. S. K. Mukerji. *Treasurer & Business Manager*:—Prof. M. O. P. Iyengar. *Counsellors*:—(1) Prof. S. R. Kashyap, (2) Prof. B. Sahni, (3) Prof. S. R. Bose, (4) Prof. P. Parija, (5) Dr. Janaki Ammal, (6) Prof. S. L. Ajrekar, (7) Prof. K. C. Mehta, (8) Dr. P. C. Sarbadhikari, (9) Prof. M. A. Sampathkumaran, (10) Dr. K. Bagchi. *Members of the Editorial Board*:—(1) Prof. B. Sahni, (2) Dr. H. Choudhury.

* * *

"NEW SCIENTIFIC INSTRUMENTS" by Messrs. Adam Hilger, Ltd., 98, King's Road, Camden Road, London, N. W. 1. (1) *Increasing the quantitative accuracy of a spectrometer.* In the pamphlet of the above title a simple eyepiece attachment, the Insta Eyepiece for a spectroscope is described. It is so designed that a spectrum line of a minor element present in a substance can be accurately compared in intensity with a neighbouring line of a principal element in the substance. The relative intensities of the lines bear a relationship to the proportions of the elements giving rise to them and when once this relationship has been established for a given substance (a fairly simple matter), quantitative analyses of samples of that substance can be carried out with great rapidity. The most useful application of this eyepiece is in the determination of exceedingly small proportions of elements. The Spekker Steeloscope is rendered still more useful by the addition of such an accessory and is listed complete with the Insta Eyepiece. (2) *The Campbell Solution Calculator.* This four-page booklet describes a novel apparatus for use in a method of calculating the behaviour of solutions described by E. A. Guggenheim and W. Hastings Campbell (*J. Soc. Chem. Ind.*, **51**, 161T. 1932). This new graphical treatment is said to have the advantage over the classical treatment that it gives not only the compositions of the various phases involved but also the quantity of each phase involved in each operation. The apparatus should be of interest to all who are concerned with processes of purification by crystallisation and like problems in chemistry, whether in research or in large scale manufacture. (3) *The Notched Echelon Cell.* This booklet describes a new device which enables absorption spectra to be taken through 10 different thicknesses of solution *in one single exposure*, yielding on the plate a multiple spectrum consisting of those taken through the ten thicknesses of solution *each* together with an appropriate comparison spectrum. The last named is formed after the light has passed through a "control" (usually the solvent in which the substance investigated is dissolved) and through a resolving sector disc producing a known and uniform degree of absorption. Reading the plate consists in observing the wavelength (or wavelengths) at which the sector density equals density absorption due to the specimen for each thickness in turn. Means of simplifying the translation of plate reading into an absorption curve are provided. Among the advantages claimed for the apparatus are simplicity, rapidity and economy of solutions. A single exposure of one minute or even less suffices to yield all the data for an absorption curve. (4) *The Spekker ultra-violet spectrophotometer.* This four-page leaflet describes, with illustration, a new apparatus for absorption spectrophotometry consisting of a combination, on one base, of a Spekker Ultra-violet Photometer (described in *Trans. Opt. Soc.*, XXXIII, No. 1, 1931-32) and a Hilger Quartz Spectrograph (F_D 20 cm.) The spectrograph can be rotated away from the photometer for use alone in emission spectra and return to its position for spectrophotometry in an instant without readjustment. The instrument reads direct in wavelengths and densities.

Ern and Technocracy.—Under the joint auspices of three Scientific Societies that held a joint session during last Easter at Bangalore, Dr. G. J. Fowler delivered an address on the new system of currency that is engaging the attention of thoughtful men all over the world. After drawing attention to the present anomalous position of 'want in the midst of plenty' owing to the faulty system of currency prevalent at the moment, the lecturer proceeded to explain the significance of the terms, *Ern* and *Technocracy*. The *Ern* is an unchangeable unit, combining as it does, the unit of energy with the universal nitrogen. Technocracy may be defined as 'the control of social growth and progress under a system of economics based on energy out-put.' Experience of the past several centuries has shown that gold has never been a trustworthy standard. Money is not necessarily gold or silver, but is essentially an undertaking by Governments to pay the equivalent according to certain accepted standards. As conceived in the past, however, it has been an unreliable measure, chiefly owing to its having been based on units (gold or silver) which have themselves greatly fluctuated in value. Credit of some sort is always necessary for business transactions but the present system, particularly the elusive form known as the bankers' credit is fundamentally unsound. It spins 'like a top on a tiny apex of gold, deriving its momentum from the uncertain force of public confidence and its extent from the wisdom or whim of the banker.' Energy representing, as it does, the capacity for doing work either in man or in nature is inexhaustible: it is interchangeable from one form to another: it is always measurable and unwavering in its value. Mechanical energy does not, however, satisfy all human needs. Food is the source of biotic energy which is necessary for the human machine to direct the forces of nature. It is made up of a number of constituents like carbohydrates, fats and proteins, but the one that is consumed most uniformly by man—irrespective of race, creed or climate—is nitrogen which has to be considered in any rational system of currency. The *Ern* combining, as it does, the forces of the factory with those of the farm thus constitutes the unit of real wealth in this world. It cannot be cornered at any time because both nitrogen and energy are inexhaustible. In the eyes of the scientific economist the present world is "very sick". The machine has mastered production, but has not achieved distribution and consumption: it has multiplied the nation but has not increased the joy. In the new world to come the will to serve must replace the will to power.

* * *

The Burrowing Habits of Pseudo apocryptes lanceolatus Bloch and Schn. At a recent meeting of the Asiatic Society of Bengal Dr. S. L. Hora exhibited specimens of this estuarine air-breathing Gobiid together with portions of a burrow which the fish make during the hot weather. He remarked on the general habits of this species of marine fish which æstivate during summer and on their general physiological condition when exhumed from their underground retiring places. While in this state, the fish depend upon the atmospheric air for supporting their respiration and the water, such quantity as may be present in the burrows, being too turbid and foul for this purpose. The utilization of air for respiratory purposes by the dipnoan fishes is well known and the observations on similar habits among the members of this species of marine fish have been made for the first time, though such habits are common among the fresh water fishes possessing an accessory air-breathing apparatus. Ophiocephalus and Saccobranchus which live in tanks drying up during the hot weather have been noticed to retire into the crevices of the soft clayey soil and remain in a state of torpor till the rains arrive. They have been taken out from a depth of two to three feet sometimes from the surface of the ground and during this period of enforced rest, their metabolic functions are at a minimum, though the gonads are in a state of intense activity. Contrary to expectations, the deposit of fat in the organs like liver, the heart and in the neighbourhood of the gonads, during this period of quiescence takes place far more rapidly and in a greater measure than during the active condition of the fish. The langour which overtakes them while in this condition is due to the low rate of their metabolism and if the hot weather is prolonged, most of the fish, especially the immature ones in which the air-breathing organs are not fully established perish. Specimens of these fresh water fish have been frequently taken from the burrows of crabs which make holes near the margins of tanks, which are flooded during the rains, thus facilitating the escape of the fish into their natural element. Dr. Hora's observations are extremely interesting and the burrowing propensities of this estuarine fish are an adaptive modification to the conditions of the habitat which they affect, an investigation into the anatomical relations of the circulatory and respiratory organs and into the physiological activity of the genital organs before and during æstivation may add certain fresh facts of far-reaching importance to our knowledge of the air-breathing examples of fishes.

* * *

We acknowledge with thanks the receipt of the following:—

"Journal of Agricultural Research," Vol. 46, Nos. 1 to 3.

"Nature," Vol. 131, Nos. 3306 to 3311.

"Chemical Age," Vol. 28, Nos. 715 to 719.

"Medico-Surgical Suggestions," Vol. 2, Nos. 3 to 4.

"Natural History," Vol. 32, Nos. 1 to 6 and Vol. 33, Nos. 1 and 2.

15th Annual Report of the National Research Council of the Dominion of Canada, Ottawa.

"Scientific Indian," Vol. 9, No. 51, March 1933.

"Canadian Journal of Research," Vol. 8, No. 2.

"The Indian Forester," Vol. 59, No. 4, April 1933.

U. S. Department of Commerce Bureau of Standards Research papers:—

471 "A New Determination of the Atomic Weight of Osmium" by Raleigh Gilchrist. 482 "The Synthesis, Purification, and certain physical constants of the Normal hydrocarbons from Pentane to Dodecane, of *n*-Amyl Bromide and of *n*-Nonyl Bromide" by B. J. Mair. 487 "A Calorimetric Method for determining the Intrinsic Energy of a gas as a function of the Pressure" by Edward W. Washburn. 488 "The Photographic Emulsion: Variables in Sensitization by Dyes" by B. H. Carroll and Donald Hubbard. 489 "A method for the separation of Rhodium from Iridium

and the Gravimetric Determination of these metals" by Raleigh Gilchrist.

"Brooklyn Botanic Record," Vol. 22, No. 2, 22nd Annual Report.

"Biochemical Journal," Vol. 27, No. 1.

"Journal of Chemical Physics," Vol. 1, Nos. 1-4.

"Arkiv fur Zoologie," Band 25, Hafte 1.

"Transactions of the Mining and Geological Institute of India," Vol. 28, Part 1.

"The Science Forum."

Report of the Meeting of the Supplemental Convocation of the University of Madras held on Monday, the 20th February 1933.

"Berichte Der Deutschen Chemischen Gesselschaft," 66, Jahrg, Nr. 4, April 1933.

"The Journal of Nutrition," Vol. 6, No. 2.

"Journal of the Urusvathi Himalayan Research Institute," Vol. 3, 1933.

State College of Washington, Agricultural Experimental Station, Pullman, Washington, Bulletin No. 276—"Observations and Experiments with Blueberries in Western Washington" by D. J. Crowley.

"Bulletin of the U.P. Academy of Sciences," Vol. 2, No. 3—

"On some Experiments with iodine vapour" by G. R. Toshniwal; "On the Determination of the Vapour Pressures of Zinc Bromide" by M. S. Desai; "On the Absorption Spectra of Alkyl halides" by P. K. Sen Gupta; "An X-Ray Investigation of the Crystals of Diphenyl Nitrosoamine" by Mata Prasad and S. G. Khubchandani; "Viscosity of Ferric Phosphate sol at various Pressures" by S. Ghosh and S. N. Banerji; "Influence of Temperature and light intensity on photosynthesis and respiration and an explanation on 'Solarization' and 'Compensation Point'" by N. R. Dhar; "Chemical Examination of the fruits of *Tribulus terrestris* Linn." by Narendra Nath Ghatak; "Peroxydase from the fruits of *Tribulus terrestris*" by N. Ghatak and K. Venkata Giri; "Studies on the Effect of Phosphates on Respiration of green leaves: 1. Eugenia Jambolana, 2. Allium Tuberosum" by U. N. Chatterji; "On an Echinstome cercaria-cercaria palustrus—with notes on its Life-History" by R. C. Chatterji.

Reviews.

EARLY BELIEFS AND THEIR SOCIAL INFLUENCE. By Edward Westermarck, PH.D., Hon. LL.D. (Glasgow and Aberdeen). Macmillan & Co., Ltd. 7/6 net. 182 pp.

In this interesting little book, Dr. Westermarck has treated the influence of early religious and magical beliefs and practices on our social relationships and institutions. He tells us that this discourse was for the most part delivered in the form of lectures at the London School of Economics and Political Science, during the Spring of 1931, and that it is based on his books, *The Origin and Development of the Moral Ideas*, *The History of Human Marriage*, *Ritual and Beliefs in Morocco*, etc., etc.

The book is divided into ten chapters. In a work covering only 172 pages, it is impossible to expect anything like an exhaustive treatment of the subjects dealt with. But those aspects which Dr. Westermarck has selected, he has treated fairly fully and all his conclusions are supported by a plentiful array of illustrations.

The first chapter deals with Religion and Magic, the precise meaning to be attached to these terms, the features that connect and distinguish them. Religion is defined as a belief in and a regardful attitude towards a supernatural being, on whom man feels himself dependent, and to whose will he makes an appeal in his worship. "In magic man attempts to influence either natural or supernatural objects or persons by supernatural means which act mechanically." No one will be inclined to question the adequacy of these definitions, especially as Dr. Westermarck himself points out that sociologists may more profitably occupy their time than by continuous quarrelling about the meaning of terms.

In the second chapter Dr. Westermarck considers the political and moral influence of Early Religion. He observes, quite rightly, that "the importance of the religious bond, and, especially, in tribes that have totemism, the totem bond, has been exaggerated by many anthropologists." Religion sometimes does influence nationality, but more frequently it is nationality that influences religion, especially among the more developed races. Islam is a democratic religion, but it has not succeeded in coalescing the Arab, the Turk, the Persian, the Syrian and the Egyptian into one nation or State. Mutual rivalries and jealousies keep them apart notwithstanding their having a common religion. In British India we are witnessing the growth of a nation whose component parts owe allegiance to a variety of religious faiths. Dr. Westermarck considers that the moral influence also of religion has often been greatly exaggerated. He states, "It seems to me to be a fact beyond dispute that the moral consciousness has originated in emotions entirely different from that feeling of uncanniness and mystery which first led to the belief in supernatural beings." One cannot be so sure that religion and morality had entirely different origins. Even if it

were so, even if religion was not the parent of morality, it is obvious that you cannot have a system of morality without a strong background of religious belief. The two have, throughout recorded history, shaped and fashioned each other.

Regarding private property with which the third chapter deals, Dr. Westermarck observes that religious sanction given to ownership is undoubtedly connected with curses pronounced by men, cursing being a frequent method of punishing criminals who cannot be reached in any other way. In the same chapter Charity is also dealt with. After pointing out the high place charity is given in all religious systems, Dr. Westermarck tries to trace the connection between charity and religion. He states that the curses and blessings of the poor partly account for the fact that charity has come to be regarded as a religious duty, containing, as they generally do, the invocation of a god. Besides the belief in the efficacy of curses and blessings, there is the connection between alms-giving and sacrifice.

A belief in the efficacy of curses and blessings, according to Dr. Westermarck, is the foundation of many of our social institutions. He traces hospitality and the right of sanctuary which are so necessary in a wild country to these sources. Regarding hospitality he says in the fourth chapter, if efficacy is ascribed to the blessings of even an ordinary man, the blessings of a stranger are naturally supposed to be still more powerful, for the unknown stranger, like everything unknown and everything strange, arouses a feeling of mysterious awe in superstitious minds. If hospitality owes its origin to the expectation of a blessing from the guest, the right of sanctuary owes its origin to the fear of the curse of the refugee. "It is not only men who have to fear the curses of dissatisfied refugees; gods are also susceptible to curses hurled at them." To the same source, *viz.*, the belief in the efficacy of curses and blessings are traced the subjection of children, and trial by ordeal. A belief in the mystic efficacy of the spoken word is said to be at least partly responsible for the virtues of truth and good faith. These and the notions of justice and criminal law are all fully dealt with in Chapters V and VI. The remaining chapters deal with "Duties to Gods", "Marriage and Sexual Relations", "Marriage Rites" and "The Position of Woman". As a general remark few will be disposed to quarrel with Dr. Westermarck's observation that men attribute to their gods a variety of human qualities, and their conduct towards them is in many respects determined by considerations similar to those which regulate their conduct towards their fellowmen. But exception must be taken to his statement: "The Vedic gods wore clothes, suffered from constant hunger, and were great drunkards." A sweeping statement of this kind will leave an altogether wrong impression on the mind of the reader.

Dr. Westermarck explains why an atheist is regarded with horror. He says "one of the greatest insults which can be offered a god is to deny his existence" and the reason is "that a person is always most sensitive on his weak points and that the weakest point in a god is his existence." This is only a half truth. Every kind of non-conformist challenges and disturbs our cherished beliefs and hopes. He affronts our understanding and weakens our self-complacency. The atheist and the rebel are penalised more as disturbers of public peace than as offenders against divine or mundane majesty. Dr. Westermarck himself notes in another place, that in early religion it is of the greatest importance that the established cult should be observed.

The last two chapters furnish very interesting reading. Many of our marriage rites, which are observed to-day without meaning or significance are tracked to their humble sources. The bulk of these rites are shown to have originated in magical ideas. Thus the custom of throwing grain or dried fruit at weddings has generally been regarded as a means of securing offspring, in accordance with the principle of sympathetic magic, grain and fruit being sources of fertility. Guns (or fire-works) are fired off at weddings to dispel evil spirits or other evil influences. Old shoes are thrown at the bridal pair in many countries in Europe. Dr. Westermarck thinks that this was meant to serve as an extra magical protection to the parties. The position of inferiority which woman has occupied in all societies and under all religious systems is ascribed to her physiological uncleanness. But it is said to have had its compensations. "The notion that woman is an unclean being charged with mysterious energy has not only been a cause of her degradation, it has also given her a secret power over her husband, and even been a source of rights and privileges."

Woman's physical weakness was at least as potent a factor as her uncleanness in reducing her to subjection. Weakness at all times has been an open invitation to the practice of cruelty and tyranny.

This rapid sketch of the contents of this admirable little book, hardly does justice to the wealth of material gathered in it, or to the close reasoning on which the conclusions are based. Dr. Westermarck's works have already become classics. Students of Sociology look for nothing but first class work from his pen, and they will not be disappointed in his *Early Beliefs and their Social Influence.*

* * *

STATISTICS IN THEORY AND PRACTICE. By L. R. Connor, M.Sc. (Sir Isaac Pitman & Sons, Ltd. 1932. 12/6.)

This is an elementary text-book suitable for students of Economics and Sociology, and is one exceedingly good at that. Simple Algebra up to the Binomial Theorem is all that is assumed on the part of the student, and accordingly the book deals up to, and with, elementary problems in sampling. There is also a chapter on the simpler problems of Finite Differences and Graduation. The more important part of this book, however, is that devoted to "Applied Statistics". In twelve chapters the whole range of economic statistics is covered and special attention should be invited to the very clear and useful chapter on Business Barometers and Business Activity Indices. It is claimed in the Preface to this book that this is an age of Statistics, to which may well be added that it is an age also of books on Statistics. This one, however, does credit both to the author and the publishers.

K. B. MADHAVA.

* * *

THERMIONIC VACUUM TUBES AND THEIR APPLICATIONS. By E. V. Appleton, M.A., D.Sc., F.R.S. Pp. 117 with 68 diagrams. (Methuen & Co., Ltd., 3*sh.* net.)

Since the publication in 1920 of Van der Bijl's excellent treatise nothing comparable to it in scope and character has been published, at any rate in the English language, consistent with the sustained and remarkable progress in the development and application of thermionic tubes.

In this small monograph, Prof. Appleton has in view the needs of the student of physics and the radio amateur desiring to obtain a proper understanding of the internal physical action of thermionic tubes and their behaviour in typical circuits. A short reference to the laws of the thermionic emission of electricity is followed by a brief description of the construction of modern receiving tubes. The influence of the geometrical disposition of the electrodes on the performance of the diode and triode are examined in a few typical cases. The chapters on the triode as amplifier, rectifier and oscillator of oscillations cover the usual ground and are models of clear exposition of the essentials. The author has touched upon such subjects as the generation of extremely short waves, soft tubes, the multi-vibrator, etc.

Even in the small space of this monograph, some mention was expected regarding transmitting tubes, their construction and their behaviour in typical cases. The author has completely omitted this aspect of the subject. Some space might have been devoted also to the advantages, in certain cases, of the use of the anode-voltage-anode current characteristics of a triode. There are a few other omissions but of a minor character.

Despite these, the book gives a very lucid and concise account of the physical action of a scientific appliance of increasing service and popularity. The list of references at the end of each chapter enhances the value of the book to the reader.

R. E.

* * *

AN INTRODUCTION TO SCIENCE, BOOK II—SCIENCE AND LIFE. By E. N. Da C. Andrade and Julian Huxley. Pages 248 (Basil Blackwell, Oxford.)

The recent introduction of the biological sciences in the syllabus of the secondary schools is a step in the right direction. Formerly, attention was concentrated on the study of the physical sciences and biology was sadly neglected. But the mere introduction of biology is not all. Even to-day the three branches of study are treated in water-tight compartments and each is studied independently of the others. This procedure is not fruitful of desirable educational results, inasmuch as it circumscribes the mental horizon of the secondary school boy. Nowadays the border lines between the branches of science are fast vanishing and this is very helpful in widening the outlook of the mind, which is the essence of scientific education. Hence the imminent necessity for a syllabus that is a harmonious blend of the three main branches of scientific knowledge.

The book under review is one intended for the boy entering the secondary school. Here the classic syllabus is treated in a novel way. The main subject dealt with is undoubtedly biology, while physics and chemistry appear as its hand-maidens. The treatment of biology or the physical sciences, in sections all by themselves is entirely dispensed with. The three subjects are treated in their inter-relationship. In the preface the authors say that this is the second of a series of four books intended to cover the whole field of elementary science. So this book is a direct outcome of Book I. As regards the treatment of the subject itself, though it lacks the rigours and austerities of the usual text-books, it arouses interest without encumbering the mind with many technical details. Throughout the book the fundamental idea of the oneness of nature is never lost sight of, and as far as possible the inter-dependence of living creatures is stressed upon. Science is here made an organized and living body of knowledge and not a class-room subject. The mysteries of the laboratory are to a great extent unravelled and treated in a manner easily understood by the beginners. The authors themselves, who are eminently qualified to the task before them, have spared no pains to make themselves explicit. Technical jargon finds no place here while the intricate workings of nature are presented in a language which is alike popular and chaste. The experiments mentioned are all amply illustrated by figures, which, while preserving a sense of proportion, are highly explanatory. The book itself is very handy and the general get-up attractive.

Without any hesitation, we would strongly recommend this book to the secondary school boys, who might be said to be at the threshold of science. The adoption of this series will, we hope, introduce a new outlook in the teaching of science in the secondary schools which is very badly needed.

C. N. R.

Two Statements.

The Alimentary Glands of the Earthworm *Eutyphœus*.

I AM sorry for the following incorrect statements made by me in my note published in the February, 1933, number of *Current Science*, which, I have now been satisfied, are not justified by the actual facts of the case:—

(1) "The work on the Physiology of the glands, now claimed by Dr. K. N. Bahl as his own was actually carried out as late as 1929 by one of our former students, now colleague in the Department."

(2) "I would certainly protest against his appropriation of the work of his colleagues and Assistants."

I withdraw these statements.

G. S. THAPAR.

I am very sorry for the words "In appropriating these results of mine" used by me in my note published in the February, 1933, number of *Current Science*, and I withdraw them.

Lucknow, K. N. BAHL.
April 23, 1933.

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